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Unprotected Sex of Homeless Youth: Results from a Multilevel Analysis of Individual, Social Network, and Relationship Factors

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Abstract

Homeless youth have elevated risk of HIV through sexual behavior. This project investigates the multiple levels of influence on unprotected sex among homeless youth, including social network, individual, and partner level influences. Findings are based on analyses of an exploratory, semi-structured interview (n=40) and a structured personal network interview (n=240) with randomly selected homeless youth in Los Angeles. Previous social network studies of risky sex by homeless youth have collected limited social network data from non-random samples and have not distinguished sex partner influences from other network influences. The present analyses have identified significant associations with unprotected sex at multiple levels, including individual, partner, and, to a lesser extent, the social network. Analyses also distinguished between youth who wished they used condoms after having unprotected sex and youth who did not regret having unprotected sex. Implications for social network based HIV risk interventions with homeless youth are discussed.

INTRODUCTION

Recent analyses of national adolescent sexual health data suggest that negative outcomes, such as higher rates of sexually transmitted infections (STIs) and unplanned pregnancies, are starting to increase after more than a decade of decline [1]. Compared with housed youth, homeless youth are particularly vulnerable to negative sexual health outcomes because they are more likely to be sexually active and engage in sexual risk behaviors, such as multiple partnerships, unprotected sex and sex trading, putting them at higher risk of being infected by the human immunodeficiency virus (HIV) and STIs [2-4]. Drug and alcohol use are also common among homeless youth [5-9], with many youth engaging in sex while under the influence [10]. Substance use is a risk factor for HIV among homeless youth through its association with sex trade, unprotected sex, and sex with injection drug users and other high-risk individuals [6, 11].

Effective risk reduction interventions that increase condom use among homeless youth are necessary to reduce negative sexual health outcomes [12]. Homeless and runaway youth in inner city areas of the U.S. are estimated to be at least 6 times more likely to be HIV infected than their housed peers [13] and risky sexual behavior is the primary means of HIV transmission for youth [14]. Pregnancy is also common among homeless youth: the lifetime rate for homeless girls is estimated at 35-45% [15, 16]. Unlike other methods of contraception, such as birth control pills, condoms are also effective at preventing HIV and

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STI transmission [17]. Unfortunately, 40-70% of homeless youth report engaging in unprotected sexual intercourse [3, 18]. Reviews of current interventions to reduce HIV risk among homeless youth found that studies of these programs either demonstrate a lack of effectiveness or are biased due to such factors such as attrition, selective reporting, and non-blinded outcome reporting [12] and have concluded that novel programs backed by findings from studies using rigorous methodology are needed [12, 19].

A recent trend in the development of sexual risk interventions for homeless youth is a focus on the association between social relationships and protective and risky sexual behavior [20, 21]. The focus on the social environment of risk behavior is consistent with the ecological approach to health interventions in which behaviors are not simply the result of individual characteristics [22-25]. An ecological approach acknowledges that: 1) understanding and intervening in health behavior requires a focus on multiple environments (e.g., social, cultural, organizational, physical) in which individual behaviors are nested; and 2) interventions should focus on specific behaviors and address the multiple levels of influence on these behaviors. One level of influence is the social network. Social networks are naturally occurring groups within which members ("alters") may influence each other's behaviors through social comparison processes, social sanctions and rewards, flows of information, support and resources, and socialization of new members [22, 26]. A "network" formally refers to the ties that connect a specific set of alters [27, 28]. Social network analysis is an effort to describe the social environment by quantifying the social relationships among this group of alters [29]. Social network studies have demonstrated associations between network characteristics and HIV risk behavior [22, 26], and studies of social network-based HIV prevention interventions have shown promise in terms of increasing condom use among participants [30].

Several recent studies of homeless youth have examined associations between their social network characteristics and engagement in risky sexual behavior [20, 31-34]. Findings suggest that homeless youth are more likely to engage in sexual risk behavior if their networks include substance users, individuals who engage in risky sex, or high conflict alters. In contrast, having a network that includes family members and peers who attend school is associated with a lower likelihood of risky sex. These studies of homeless youth have yielded encouraging findings for the development of peer-based interventions that aim to mobilize positive network influences to reduce risky sexual behavior, but also have a number of limitations. First, most are based on purposive/convenience samples of youth recruited from specific types of venues (e.g., shelters or drop-in centers) and thus study findings cannot be generalized to larger populations. Second, most have collected limited network data using a narrow definition of a social network. For example, one study [31] asked a purposive sample of youth in street and service sites around Washington D.C. about a maximum of seven people they "see a lot and spend most of your time with now" and over 25% did not name any network members. Another study [32] used the same data collection method with a non-random street sample of youth in three Midwestern cities, but limited the number of network members to a maximum of two and nearly 5% did not name any network members. A third study of a convenience sample from one drop-in center in Los Angeles [20] elicited an unlimited number of network nominations but used a series of specific network member name generator prompts (which can introduce unknown bias resulting in more or fewer nominations of certain types of alters [35]) and collected personal network structural data [39] using a network freestyle drawing technique [36] (which is known to produce fewer and more homogenous ties than techniques that ask respondents to evaluate each unique dyad within the network [37]). In addition, this latter study presented data limited to the friendship ties only [20].

Perhaps the most important limitation to previous studies of the effects of network characteristics on unprotected sex among homeless youth is their lack of distinction between network members who are sex partners and those who are not. Several studies have demonstrated the importance of relationship and partner characteristics in the decisions to use or not use condoms [38-41]. Understanding the influence of emotions in sexual relationships is a key factor in understanding risky sexual behavior, including engagement in unwanted sexual behavior [42-44]. Consistent with the ecological model of health, which suggests that there are multiple influences on behavior, including partner influences [24], one study of unprotected sex among homeless women demonstrated predictors of unprotected sex at the individual, social network, partner and relationship levels [45]. The studies we reviewed of the social network influences on risky sex among homeless youth reported associations between aggregated social network characteristics and unprotected sex as an individual characteristic. This approach makes it impossible to determine if the association is due to social network influence or a respondent's relationship with a particular sexual partner. For example, one study [20] reports that homeless youth who had at least one street-based peer who used condoms regularly were more likely to use condoms themselves. However, those respondents who listed sex partners in their networks may be basing their evaluation of a peer's condom use on their own behavior with the peer.

To develop interventions that reduce risky sex among homeless youth, it is important to understand the relative strength of sex partners' influence compared to the larger social network in order to target the most important levels of influence. The findings from these existing studies do not provide enough evidence that social network based interventions would be more effective than relationship-based HIV interventions [46] or educational-based interventions [13]. Although social network HIV interventions have demonstrated effectiveness, they are challenging to implement due to methodological complexity and difficulty developing recruitment strategies that require knowledge of particular networks prior to implementation [30]. These challenges underline the need to understand the role and importance of social networks in influencing unprotected sex among homeless youth relative to other influences.

The goal of this study was to explore the multiple influences on risky sexual behavior among homeless youth with a multi-stage, multi-method approach and to provide empirical findings that inform the development of novel theories and programs to reduce HIV risk behavior among homeless youth. Our first aim was to address the limitations of previous studies of social networks and HIV risk behavior among homeless youth by conducting a personal network study with a probability sample of homeless youth from service sites and street locations in Los Angeles County. We elicited a large number of network alters for each respondent using a generic name generator. We measured both network composition and structure with systematic dyadic personal network data collection and analysis techniques used to study HIV risk in other homeless populations [47]. Our second aim was to explore which factors at the multiple levels of influence were most strongly associated with unprotected sex [47]. We analyzed the association between these multiple-level factors and unprotected sex using three stages of analysis across two studies that prioritized exploration and generation of new insights rather than confirming or disconfirming existing theories [48]. In the first stage, we analyzed qualitative data from a mixed-method personal network interview with 40 homeless youth in order to develop working hypotheses about how social network characteristics may influence youth risk behavior and to identify cases to provide illustrations of how various influences contribute to condom use. In the second stage, we conducted bivariate tests with data from a larger study of 419 homeless youth in order to identify the variables at different levels (social network, individual, and partner) that had the strongest associations with unprotected sex. In the third stage, we built and tested multivariate, multi-level models to further examine these associations while controlling for

non-independence of measurements at different levels of analysis [45]. This study is the largest and most comprehensive comparison of the relative importance of individual, partner, and social network effects on unprotected risky sexual behavior among homeless youth.

STUDY 1 (QUALITATIVE ANALYSIS)

METHODS

Participants—We conducted semi-structured interviews with 40 homeless youth (20 female, 20 male) recruited from five community shelters and drop in centers serving primarily homeless and/or runaway adolescents in the Hollywood and Westside regions of Los Angeles County, California. The goal of these interviews was to generate hypotheses, identify key variables for a larger quantitative study, and to identify illustrative cases to assist in the interpretation of findings. These interviews also served to confirm the feasibility of collecting extensive social network data from homeless youth. Youth were eligible for the study if they were ages 13-23, left home for the first time prior to age 18, were not currently living with or receiving support for food or housing from a parent/guardian, and spent the previous night homeless (slept the previous night in either a) a shelter, public place, with someone they didn't know, or in some other situation because they did not have a regular place to stay; or b) at a friend's place or in a hotel room or some other place that they rented with friends because they did not have a regular place to stay). Interviews were conducted between August and October 2007.

Procedures—We conducted a two-part mixed-method interview with these youth. The first part included a structured personal network interview that produced a visualization of the respondent's social network which was used as an elicitation prompt to generate open ended responses to questions about social network members. Following procedures used in other studies of homeless populations [49] we asked respondents to name 25 people in their personal network who were 13 years of age or older. Personal networks encompass the ties that surround a single focal individual, in this case, a homeless youth [47, 50]. We followed established procedures for conducting personal network interviews [35, 47, 50]. Personal network interviews are typically divided into three sections: questions designed to generate the names of people in the respondent's social network (alters), questions about each alter (network composition), and questions about the relationship between each unique pair of network alters (network structure). First, in the Alter Name Generation Section, we asked respondents to name, by first name or nickname only, 25 individuals that they knew, who knew them, and with whom they had contact sometime during the past year or so. Contact could be face-to-face, by phone, mail or e-mail.

Immediately after answering questions about themselves, the 25 alters, and the relationships among the alters, we produced visualizations of the respondent's own networks based on their responses. We produced the visualizations using the spring embedding algorithm that is included in the software Egonet, which is designed for the collection and analysis of personal networks [51]. We asked the respondents to look at the graph and identify and describe distinct clusters of alters (components) and alters with no connections (isolates). We also asked them an open ended question: "Who has the most influence on your decisions about sex?" Interviewers recorded responses to this question with notes, which we analyzed with a pile sorting technique for identifying themes in qualitative data [52] to identify types of influences.

We also conducted a semi-structured interview with the respondents about two recent sexual events using the same procedures used in exploratory studies of HIV risk behavior among homeless women [53] and homeless men [54]. Interviews were audio-recorded in order to

produce verbatim transcripts, which were used to write summary vignettes [55] of each event and sexual relationship between respondents and partners described across all interviews. We reviewed the vignettes in conjunction with the open-ended responses to the question about the network visualization to identify three cases that illustrated the range of influences on sexual behavior and the ways in which these influences impacted decisions to use or not use condoms.

RESULTS

All 40 respondents were able to name 25 alters and complete the personal network interview. Respondents named three types of influences on sex decisions: twenty-one of these 40 respondents named sex partners as influencing their decisions about sex, 8 mentioned social network influences (4 relatives, 4 friends), and 19 said that they were not influenced by anyone other than themselves. Figure 1 presents three examples of networks discussed by respondents (with alter labels removed), the qualitative responses to the open ended question about the primary influences on their sexual behavior, and quotes from the recent event interviews that illustrate the influences on their decisions to use/not use condoms. The top figure is from a respondent who said that a sex partner had the most influence over her decisions about sex. She mentioned that she typically uses condoms with her "casual" partners but does not use condoms with the influential partner because he does not want to use them and having sex with him makes her feel special. However, she expressed regret over not using condoms with him the last time they had sex and "prayed to God" that she would not get pregnant or "catch anything" from him. The middle figure is from a respondent who said that no one influenced his decisions to have sex except himself. However, when he described his relationship with his girlfriend, he said that she decided to have vaginal sex without a condom and he went along with it. He said that he did not feel any regret over having unprotected sex with her because she was already pregnant (with someone else). He said that he always uses condoms with other partners to protect himself from disease. The bottom network is from a respondent who identified an influential non-sex partner network tie (her mother) who is a positive influence on her decisions not to have risky sex. However, in the semi-structured interview this respondent described two recent unprotected sex events. She said that she did not use condoms the first time was because she was ignorant about condoms and did not use them the second time because she was "being stupid" by not caring about the consequences.

DISCUSSION

The analyses of the qualitative data based on exploratory questions about key network influences enabled us to identify novel hypotheses and variables influencing unprotected sex for homeless youth. These results also confirmed the feasibility of conducting a more extensive personal network interview and guided our approach to testing for the predictors of unprotected sex with quantitative data. These examples illustrate that decisions about condom use are affected by different types of influence: individual, social network and romantic partner. The examples illustrate both willingness to engage in unprotected sex and also engagement in unprotected sex due to other factors (e.g., the preferences of their partner). This indicated that there may be different pathways to unprotected sex for homeless youth: sometimes they engage in unprotected sex and are not concerned about its consequences and sometimes they regret their actions after the fact. While unprotected sex is a health risk for homeless youth regardless if it is willing or not, anticipation of negative emotions (e.g. regret, shame, guilt) has been found to prospectively predict condom use and condom use intentions [56, 57]. Therefore, those who engage in unwanted unprotected sex may be less likely to engage in unprotected sex in the future. Based on these findings, we decided to explore the predictors of unwanted unprotected sex separately from wanted unprotected sex in order to better understand these two pathways associated with different

stages of potential behavior change [58]. Identifying which influences have the strongest association with unprotected sex is important for the design of interventions targeting this behavior.

We also identified multiple influences on unprotected sex: characteristics of partners and relationships appeared to have a strong effect on unprotected sexual behavior. Individual level characteristics and attitudes also appear to have an influence on risky sexual behavior. We hypothesized that social network influences would be weaker than particular sexual partners/relationships because the responses to the open ended questions and the illustrations did not suggest strong effects of social networks on sexual decisionmaking. Social network influences were listed fewer times than partner influences and individual influences. Also, the respondent who identified her mother as discouraging her from engaging in risky sex did not use condoms in either of the events she described, illustrating the limited effect of this social network influence. We tested these hypotheses in the quantitative study described below.

STUDY 2 (BIVARIATE AND MULTIVARIATE ANALYSIS)

METHODS

Participants—We interviewed 419 homeless youth in Los Angeles County with a broad structured survey instrument examining the social context of substance use and HIV risk within this population. Youth were eligible for the study according to the same eligibility requirements for the pilot interview (see above), with the exception of a slightly broader age range of 13-24. Interviews were conducted between October 2008 and August 2009. Of the 446 youth who initially screened eligible for the study, 437 were interviewed. Of those interviewed, 18 were later found to be ineligible and excluded from the sample because they were too old ($n = 2$), or were suspected to be not homeless ($n = 1$), or were repeaters ($n = 15$). This resulted in a study sample of 419 and a response rate of approximately 98%. We report on results from two analytic samples. The first sample consists of 240 youth who reported being sexually active in the past 3 months and named at least one non-need-based sex-partner (defined as a partner who is neither a casual nor primary partner and is "someone a person has sex with because they need money, food, a place to stay, drugs or alcohol, or something like that") in their social network. The second sample consists of 161 of these youth who named at least one partner with whom they engaged in any unprotected sex in the past 3 months. After providing informed consent, computer-assisted face-to-face structured interviews were conducted by trained interviewers. These interviews lasted an average of 60 minutes, and youth were paid $25. The research protocol was approved by our institution's internal review board and a Certificate of Confidentiality was obtained from the National Institutes of Health.

Sample Design—To obtain a representative sample of homeless youth from the greater Los Angeles area, we designed and implemented a probability sample of homeless youth recruited from shelters, drop-in centers, and street venues in the study area. Specifically, we adopted a two-stage design that involved first developing a list/sampling frame of sites used by homeless youth and then sampling youth within the selected sites. We developed two sampling frames of sites: one for eligible service sites (shelters and drop-ins) and the other for street venues in the study area. The first sampling frame was developed using existing directories of services for homeless individuals. Service sites were considered eligible if they were located in the study area and the majority of their clientele was ages 13 to 24 and English speaking. Service sites not limited to that age group were eligible if they had a specific program geared toward youth. In addition, for short-term transitional housing programs, the average length of stay had to be one year or less. Our final list of service sites consisted of 22 eligible sites: 15 shelters and 7 drop-in centers. All the eligible service sites

in the study area that agreed to participate in the study were selected and can be considered strata. The second sampling frame, for street venues, was developed with the assistance of service providers and outreach agencies. We ultimately identified 19 street venues in the study area where homeless youth congregate and hang out. All of these street sites were included in the study and thus can be considered as strata. Each of the 41 service and street sites were investigated intensively with the purpose of obtaining an estimate of the average number of youth served daily by the service sites and the average number of youth that congregate at the street venues in a given day. This information was used to assign an overall complete quota to each site, approximately proportional to the size of a site. The second stage of the sampling design consisted of drawing a probability sample of homeless youth from the 41 study sites. Strategies specific to site type based on availability of a sampling frame (e.g. randomly selecting youth from bed lists at shelters vs. using a random walking technique in outdoor hangouts [59]) were developed to select randomly the youth to be approached, screened and interviewed.

The proposed sampling design deviates from a proportionate-to-size stratified random sample (where a constant proportion of the population is sampled from every site) because of: changes in the sampling rates during the fielding period; differential response rates of youths across sites; and variability in how frequently youth access shelters, drop-ins and street venues. This last factor means that some youth are more likely than others to be included in the sample for a given site. We accounted for the differential frequency of using sites by asking respondents how often they had gone to a shelter, drop-in or street venue in the study area during the past 30 days and using this information to correct the respondent's sampling probability. We corrected departures from a proportionate-to-size stratified random sample with sampling weights.

Study Design: Personal Networks—We followed the same procedures for collecting personal network data described in Study 1 with the exception of asking the youth to identify 20 instead of 25 alters. We selected 20 alters because it was small enough number of alters to reduce respondent burden but large enough to reduce the bias and capture variation appropriately in measures of network composition and structure [49, 60]. Immediately after generating names of 20 alters, we asked respondents if they had named each of their recent sex partners among the 20 alters. If not, we collected the additional names of up to 4 sex partners. The names were then used in the second section, Alter Composition, which required youth to answer a series of questions about each alter, including their background characteristics, behaviors, and relationship with the respondent. Third, in the Network Structure section, for each unique pair of network alters, we asked how often these two people interacted with each other.

These personal network interview procedures provided data for a multi-level analysis of sexual risk behaviors [61]. To measure the inherent relationship characteristic of unprotected sex, while also recognizing the individual level contributions to consistent condom use, we analyzed data at two levels. At the highest level (level 2, individual level), we analyzed variables measuring the youths' demographic characteristics, attitudes about condoms and perceived HIV susceptibility, and social network composition and structure. At the lowest level (level 1, partner/relationship level) we analyzed variables measuring partner characteristics and characteristics of the relationship between the respondents and their partners. Also at the lowest level are the dependent variables, unprotected sex and unwanted unprotected sex with a particular partner.

Measures: Level 1 Variables (Partner/Relationship)

Dependent variable 1: *Unprotected sex* with the individual partner was derived from two items asking how frequently respondents had sex with the partner in the past 3 months and how frequently they used male condoms when they had sex. Responses were dichotomized as: 0 = always used condoms vs. 1 = ever engaged in unprotected sex.

Dependent variable 2: In order to test a hypothesis developed from the qualitative analysis, *unwanted unprotected sex* with a partner was derived from an item asking respondents who did not always use condoms with a partner if they ever wanted to use a condom but did not: 0 = no vs. 1 = had unwanted unprotected sex. This question was not asked if respondents always used condoms with the partner and the variable was set to missing for these dyads.

Partner characteristics were assessed by seven items. Respondents were asked about background characteristics of their partners: if they 1) *went to school regularly*, 2) *had a steady job*, and 3) were *homeless*. Respondents were also asked about the risky characteristics of their partners: 4) if their partners *drank to the point of being drunk*, 5) *used drugs*, 6) or *had risky sex* (multiple sex partners, sex with someone they didn't know, or didn't use a condom with a new partner). A value of 1 was given to these variables if the respondent said yes and 0 if no. They were also asked 7) if their partner had *tested negative for HIV*. If the respondent knew that the partner had tested negative, the variable was given a value of 1. All other partners (those who had tested HIV+ and those with unknown HIV status) were given a value of 0 for this variable.

Relationship characteristics were assessed in terms of communication with the partner about risky sex, strength of their relationships, relationship abuse, drinking and/or using drugs during sex with the partner, the connectedness of the partner to the rest of the network, and the type of relationship in terms of the combination of respondent's and partner's biological sex. Communication was assessed with two questions: respondents were asked if they had ever *discussed condoms* and *discussed HIV prevention* with the partners (1 = yes, 0 = no). Relationship strength was measured with two variables. First, *relationship commitment* was assessed with a three-item relationship commitment scale (alpha = .60). Respondents were asked how much they agreed or disagreed (strongly disagree = 1, strongly agree = 4) with statements characterizing their relationships, such as "Your life would be (was) very disrupted if (when) this relationship ended," and "You are (were) extremely committed to this relationship." These ratings were averaged for each partner. This scale is a modified form of a scale used in previous studies of romantic relationships, including a study of unprotected sex among homeless women [41, 45, 62-64]. We retained the three items that had the most face validity for measuring commitment in homeless youth relationships (based on our exploratory interviews) and the scale showed good convergent validity in our sample ($r = -0.61$, $p<.001$) with a question rating the seriousness of the relationship (1=married, 2=boyfriend/girlfriend, 3=casual partner, 4=need-based partner). Second, r*elationship length* was measured by asking respondents how long they had known the partner (converted to number of days). *Relationship abuse* was assessed with a dichotomous variable equal to 1 if the respondent endorsed any of the following three items: the partner had ever hit, slapped, or physically hurt the respondent, called the respondent names or swore at them, or made them feel unsafe in the relationship. *Respondent's substance use before or during sex with the partner* was assessed with separate items asking about the proportion of times alcohol and drugs were uses before/during sex during the past 3 months ("never" = 0, "less than half the time" = .25, "half the time" = .50, "more than half the time" = .75, "always" = 1.0).

Partner network connectedness was measured with two variables that were constructed from a series of questions we asked about the relationships among all of the network alters.

Respondents were asked how often each unique alter-alter pair had contact with each other in the past 3 months: "never," "rarely," "sometimes," or "often." Based on these answers, we calculated the partners' *degree* [29], which is the number of other alters that the respondent said the partner interacted with at least "sometimes." We also created a dichotomous *isolate* variable equal to 1 if the partner was completely disconnected from other network members (degree = 0) and 0 if they had at least one connection. Partner connectedness has been shown to be indirectly associated with condom use among adolescents [65]. Two dummy variables were created to represent the *biological sex type of the relationship*: relationships consisting of 1) male respondents who named male or transgendered partners and 2) male respondents who named female partners (vs. female respondents who named male partners.)

Measures: Level 2 Variables (Individual)—Demographic and background variables included *high school graduate or GED* (vs. not), *race/ethnicity, income* in dollars per month, and total *years homeless*. Other background variables relevant to risky sexual behavior among poor and homeless adolescents were also included: *experience with family abuse* before leaving home (physical/verbal abuse, inappropriate sexual touching) [66] and *degree of migration* since leaving home (number of states stayed in) [67].

Respondent sexual experiences were measured with four variables. All respondents were asked for the *number of recent sex partners* (3 months) and if they had *ever been tested for HIV*. To control for possible non-use of condoms due to pregnancy or pregnancy desires, female respondents were asked if they had *become or tried to become pregnant* or had been *using birth* control other than a condom in the past 3 months.

Attitudes about condoms, HIV vulnerability, and pregnancy were assessed with a scale assessing *positive condom use attitudes* that was comprised of four items asking whether condoms interfere with the enjoyment of sex, condoms can be used without ruining the mood, you can stop before sex to use a condom, and it would be okay if a partner suggested that a condom be used [68]. Each item was rated on a 4-point scale (1 = *strongly disagree* to 4 = *strongly agree*; alpha = .56), with higher scores indicating more positive attitudes towards condom use. The scale has been previously validated [69] and has been associated with condom use among injection drug users [68]. *Perceived susceptibility to HIV* was assessed with four items such as "It would be easy for you to get the HIV infection or AIDS" and "Your behavior puts you at risk of HIV/or AIDS." Each item was rated on a 4-point scale (1 = *strongly disagree* to 4 = *strongly agree*; alpha = .62), with higher scores indicating greater perceived susceptibility. To further control for possible non-use of condoms due to pregnancy desires, we used two items to assess attitudes towards pregnancy, with slightly different wording for female and male respondents: how *upset or pleased they would feel if they found out today that they were pregnant/got a girl pregnant* (1 = *very upset* to 4 = *very pleased*) and thinking about their lives right now, *how important is it to avoid getting pregnant/getting a girl pregnant* (1 = *very important* to 4 = *not at all important*).

Network characteristics: Because this is the most comprehensive study of social networks and unprotected sex among homeless youth, we explored the association between a large number of social network measurements and unprotected sex. We included social network variables that potentially represented positive or negative influences on sexual risk behavior [33]. We constructed either ordinal dummy variables or dichotomous variables of network composition depending on the distribution of responses in order to best capture the variability in numbers of different types of network members. We constructed dichotomous measures to indicate if respondents had any of the following types of alters in their networks (1 = yes, 0 = no): an *adult in a position of responsibility* (service provider, employer,

teacher, etc.), an alter who a respondent *drinks with*, an alter who a respondent *does drugs with*, an alter the respondent *met online or on a phone line*, an alter *met in a shelter*, any alters *met on the street*, and any alters who are *homeless*. We constructed two dummy variables (1-2 alters or 3+ alters vs. none) to measure the number of alters in a respondent's network who had the following characteristics: *go to school regularly, family members*, and *likely to engage in risky sex* (multiple sex partners, sex with someone they didn't know, or didn't use a condom with a new partner). To isolate the effect of exchanging information about HIV among social networks from discussing HIV with sex partners, we calculated the proportion of *non-partner alters with whom the respondent had discussed HIV*, which was associated with unprotected sex in a study of homeless women [45].

To explore the network effects beyond network composition, we constructed several measures of network structure, including measures that incorporated both structural and composition characteristics [29]. Structural measures have been associated with risky sexual behavior in previous research [70]. We dichotomized the network based on alters interacting with each other at least "sometimes" and calculated network *density*, which is an index that represents the proportion of ties that exist in a network relative to the total number of possible ties, and varies from 0 to 1. We also calculated *centralization*, which is another index between 0 and 1 that measures the degree to which one or a few individuals in the network maintain the majority of ties, *number of isolates* (alters alters with no connections to other alters), and the *size of the largest component*, which is the number of alters in the largest group of alters who are connected to each other either directly or indirectly. To explore if the degree of network connections among risky network members was associated with the respondents' own risky behavior, we calculated the *density and centralization* within the group of alters who were rated by the respondent as *having engaged in risky sex*.

Data Analysis—To test which variables best predicted the *unprotected sex* and *unwanted unprotected sex* controlling for other variables within and across levels, we built a multivariate, multi-level logistic regression models with the one-to-many personal network design [61, 71]. We used the "gllamm" procedure in Stata 9.2 [72] with a binomial family, and a logit link to test associations between the predictor and outcome variables. To determine which variables were the best candidates for the final model, we first ran each variable alone in a bivariate model predicting each dependent variable. We included variables that were significantly associated with the outcome variables at the 90% confidence level in subsequent multivariate gllamm models with demographic variables as controls.

RESULTS

Descriptive Statistics—Table 1 presents weighted descriptive statistics for individual-level characteristics, Table 2 presents weighted descriptive statistics for individual-level social network characteristics, and Table 3 presents weighted descriptive statistics for the dyadic-level partner/relationship characteristics. Each table presents either percentages for dichotomous variables or means and standard errors for continuous variables. There were 240 respondents and 339 partners (dyads) included in the unprotected sex analysis. A subset of 161 respondents and 207 partners (dyads) who engaged in unprotected sex were included in the unwanted unprotected sex analysis.

Bivariate Results—Tables 4 and 5 present the results of bivariate logistic multi-level models. The tables present odds ratios (OR) and 95% confidence intervals (95% CI) predicting both unprotected sex and unwanted unprotected sex. Table 4 presents the results of models with all of the individual and social network level variables. For the individual level characteristics, positive attitudes towards condoms were significantly associated with a

lower likelihood of unprotected sex and a higher likelihood of unwanted unprotected sex. In addition, history of childhood abuse was significantly associated with a higher likelihood of unprotected sex, and migration experience was associated with a lower likelihood of unwanted unprotected sex. For the social network composition variables, school attendance among alters, and having any alters who were drinking partners and recently homeless predicted unprotected sex. Having any alter who was an adult in a position of responsibility was associated with a lower likelihood of unwanted unprotected sex (and the only social network predictor of this outcome). None of the structural network characteristics predicted either outcome variable in bivariate tests.

Table 5 presents the bivariate logistic multi-level models with all partner/relationship level variables. For the partner background characteristics, unprotected sex was significantly less likely with partners who attended school regularly, significantly more likely for partners who tested negative for HIV, and marginally more likely for homeless partners. Only a partner's negative test for HIV was significantly associated with unwanted unprotected sex at the partner level: respondents were less likely to report unwanted unprotected sex with partners who tested negative for HIV. At the relationship level, communication within the dyad about HIV risk and the respondent's commitment to the relationship were associated with increased likelihood of unprotected sex and decreased likelihood of unwanted unprotected sex. In addition, abuse within the relationship and the number of connections that the partner had to other social network members emerged as risk factors for an increased likelihood of unprotected sex. The proportion of times that the respondent drank either before or during sex with the partner was associated with an increased likelihood of unwanted unprotected sex. Finally, in terms of the sex-type of the relationship (the biological sex of the respondent and partner), compared to female respondents and male partners, male respondents had lower odds of reporting unprotected sex with male partners and higher odds of reporting unwanted unprotected sex with female partners.

Multivariate Results: Unprotected Sex—Table 6 presents the findings from the two multi-level multivariate logistic regression models. Independent variables in these models included all independent variables from bivariate models with p-values of less than .10. Two individual level variables predicted unprotected sex: history of childhood abuse and attitudes about condoms. Respondents with a history of childhood abuse had nearly 6 times the odds of reporting unprotected sex compared to those without a childhood abuse history, controlling for demographic and other individual level characteristics, social network characteristics, partner characteristics, and relationship characteristics. Respondents who had positive attitudes about condoms were less likely to report unprotected sex, controlling for these other variables: each point increase in the positive condom attitudes scale represented approximately a 50% reduction in the odds of unprotected sex. None of the network characteristics significantly predicted unprotected sex in the full multivariate model. For the partner and relationship effects, dyads that consisted of a partner who went to school regularly had only 16% the odds of engaging in unprotected sex compared to other dyads, controlling for other factors. In addition, unprotected sex was more likely among those who were more committed to the partnership: for each 1 point increase in the relationship commitment scale, the odds of unprotected sex increase by 6.7 times. No other variables were significant.

Multivariate Results: Unwanted Unprotected Sex—Two individual level variables were associated with having unwanted unprotected sex: migration experience and positive condom attitudes. For each additional state traveled, the odds of having unwanted unprotected sex decreased by 21% and each point increase in the positive condom attitude scale represented around a 29% increase in the odds that a respondent wanted to use a condom when having unprotected sex with a partner. In the case of social network variables,

respondents who had responsible adults in their networks had only 11% the odds of reporting unwanted unprotected sex with a partner compared to respondents who did not name a responsible adult. This was the only network characteristic associated with *either* outcome variable. The odds of wanting to use condoms during unprotected sex for dyads in which partners discussed HIV prevention were only 18% compared to the odds for dyads with no HIV prevention discussion. Partner characteristics, AOD use in combination with sex, and the relationship sex-type were not significantly associated with having unwanted unprotected sex.

DISCUSSION

This study presents findings from the most extensive investigation of the social network influences of risky sex among homeless youth. Our findings identified multiple levels of influence on engagement in and/or desirability of unprotected sex, including influences at multiple levels. Both qualitative and quantitative findings identified individual and partner/relationship level influences on these outcomes and neither approach found much support for social network level influences. This study's findings confirm some previous work on the factors that contribute to HIV risk behavior among homeless youth and challenge others. For example, our study found that relationship commitment is a strong predictor of having unprotected sex, similar to findings from several other studies with different populations [41, 45, 73]. We also found that respondents who discussed HIV prevention with their partner prior to engaging in unprotected sex had much lower odds of wanting to use a condom. The qualitative analyses illustrate how communication can precede unprotected sex: two of the example respondents described discussing condom use with their partners prior to engaging in unprotected sex. These findings suggest that communication by couples prior to sex may help lower concerns about HIV and pregnancy. We also found that consistent condom use was more likely in relationships with partners who went to school regularly. This confirms the association between having contact with peers attending school and lower odds of unprotected sex among homeless youth [74]. These results underline the conclusions of previous studies that argue for the importance of romantic partners and romantic relationships on adolescent health behaviors [75-79]. They also support other studies that have emphasized the dyadic nature of condom use and the need to treat romantic dyad effects differently than other peer effects [42, 80].

In our multivariate models, individual characteristics remained significant, even after controlling for social network and partner/relationship characteristics. For example, having positive attitudes towards condoms was associated with lower odds of engaging in unprotected sex and, when condoms were not used, with higher odds of wanting to use condoms. Also, youth with a history of abuse prior to leaving home have a higher risk of engaging in unprotected sex, confirming findings of earlier studies [81]. One of the more interesting significant associations at the individual level was the finding that the more states homeless youth have lived in since leaving home, the less likely they were to say that they wanted to use condoms when they had unprotected sex. Although the relationship between these two factors may not be obvious, this finding is consistent with another study of homeless youth that found that the subgroup of migratory homeless youth are more likely to engage in a variety of risky behaviors [67].

Unlike previous studies, [20, 31-33], the present study found no social network correlates with unprotected sex. Also, we found only one (negative) network association with unwanted unprotected sex: naming at least one adult in a position of responsibility. We found a marginal association between school attendance of social network members and unprotected sex in a bivariate model, similar to another study [74], but it weakened to non-significance in the multilevel multivariate model which controlled for the romantic partner's school attendance. This suggests that condom use among homeless youth with ties to

school-based peers may be due to the partner's motivation to use condoms rather than a more general pro-social network influence. This finding underscores the importance of our multi-level social network approach to understanding risky sexual behavior. Unlike previous studies that explored aggregate social network influences on risky sex among homeless youth, we analyzed influences at both the aggregate social network level and the dyadic level. Our findings suggest that characteristics of particular relationships have a stronger influence on risky sex than the aggregate characteristics of homeless youth's social networks. The qualitative findings reinforce these quantitative findings: social network influences were listed much less frequently as influences on decisions about sex than individual and partner influences. Also, the example of a respondent influenced to not engage in sex by a social network member illustrated the ineffectiveness of this influence by describing multiple recent unprotected sex events.

These multi-level findings are consistent with ecological model approaches to health behavior intervention development, which recommend multifaceted interventions that target multiple influences at different levels to affect behavior change [24]. Understanding the effects that these multiple influences have on specific types of behaviors is an important first step in the design of effective interventions. Our quantitative findings confirm the educational focus of existing HIV risk reduction interventions that promote education about how to use condoms and the benefits of using condoms. This is illustrated by the qualitative case that discussed engaging in unprotected sex primarily because she did not know anything about condoms. However, our quantitative and qualitative findings also reiterate the findings of studies over the past several decades that demonstrate that education alone is not sufficient to prevent unprotected sex [42, 82]. Several of our findings point to the strong role that emotions play in making unprotected sex more likely, suggesting that these emotional factors may outweigh knowledge of how to use condoms or the causes of HIV. Two of our qualitative examples illustrated that, despite positive attitudes towards condoms and concerns about pregnancy and STIs, engagement in unprotected sex sometimes was influenced by emotional factors rather than a lack of knowledge. For example, one of the qualitative examples illustrated how concerns about pregnancy and disease were less important than the desire to maintain a feeling of closeness to her partner. Several of our multi-level quantitative findings also suggest emotional roots of unprotected sex. For example, we found that respondents with a history of childhood abuse were more likely to engage in risky sex. Abuse in childhood and parental neglect often have long lasting effects on adolescent and adult romantic relationships and risky sexual behavior, primarily through emotional and relationship dysfunction [83]. Many studies have shown very high rates of physical and/or sexual abuse and parental neglect among homeless youth compared to housed youth [19], which point to the importance of developing interventions that help homeless youth cope with the emotional roots of unhealthy behavior and relationship dysfunction to reduce HIV risk behavior [46, 84].

In addition to individual level emotional factors, we found that emotions within particular relationships, specifically relationship commitment, were also associated with unprotected sex. Many studies of unprotected sex do not address the meaning that condom use has within a relationship and the consequences a request for the use of a condom might have on an individual's perception of themselves, their partner, and their relationship. Condoms can interfere with the desire to develop and maintain a close, intimate trusting relationship because of their association with promiscuity, infidelity, and mistrust. For individuals in highly committed relationships, the costs of requesting a condom, such as relationship break-up or the loss of the feeling of intimacy and trust, might seem to outweigh the costs of unprotected sex, especially if the likelihood of becoming pregnant or infected with an STI seems relatively less likely than negative relationship consequences. Couples may engage in cognitive distortion to reduce their concerns about HIV and pregnancy to maintain their

feelings of intimacy and trust [73]. Our finding that communication about HIV increases the odds of unprotected sex is also consistent with this hypothesis.

This study has important implications for the development of social network focused interventions into HIV risk behavior of homeless youth. While some studies have argued that targeting social networks may have important implications for HIV prevention among homeless youth [20, 21], the only significant network association we found was between network composition and unwanted unprotected sex. At first glance, the finding that having an adult in a position of authority decreases the odds of unwanted unprotected sex suggests a negative influence on HIV risk behavior among youth who have a seemingly pro-social network influence. However, it seems unlikely that these adults influenced youth to want to engage in risky behavior: respondents considered these alters less likely to engage in risky sex compared to other types of alters (chi sq = 22.14, p<.0001). They also considered them less likely to drink to intoxication (chi sq = 46.84, p<.0001) and use drugs (chi sq = 81.00, p<.0001). A more likely explanation is that youth who willingly take risks may be more likely to be in closer contact with these types of adults because they are more likely to have problems that require their assistance. These adults were primarily service providers of shelters (social workers, mental health counselors, drug treatment counselors, etc.) and youth were more likely to think of them as leaders (chi sq = 39.28, p<.0001) and more likely to value their opinions (chi sq = 22.55, p<.0001). Unfortunately, these adults were no more likely to discuss HIV with respondents than other alters. Rather than suggesting a negative social network influence on homeless youth, this finding may suggest that adults in positions of responsibility in the lives of homeless youth represent a latent source of positive influence on the HIV risk behaviors of the most at-risk homeless youth.

One study of migratory homeless youth suggests that a social network intervention directed at these youth might be more successful than alternate interventions due to their tendency to have risky individuals in their social networks and their general aversion to traditional services [67]. Our finding that migratory homeless youth are less likely to be concerned about unprotected sex supports the suggestion that these youth may require custom HIV prevention interventions. However, our study's findings did not support previous research demonstrating a network influence on risky sex. The likely reason that our findings diverged from previous research is that this study is the only one to use a multi-level modeling analysis approach to investigate the effects of individual partners, separate from other partners and the rest of the social network. This is likely the main reason why social network effects were significant in bivariate models but not in the full model that included social network, individual and partner/relationship characteristics. Models that predict aggregate unprotected sex behavior across partners and aggregate sex partner characteristics with other social network members are unable to distinguish between these distinct social network and partner/relationship effects. Therefore, we cannot conclude that there is evidence that network based HIV interventions targeting the unprotected sex of homeless youth would be more effective than relationship-based [46] or education-based interventions [13].

We believe that this study uses more detailed, extensive and sophisticated methods than existing studies of the social networks of homeless youth. However, this study has some limitations that should be considered when interpreting the results. Our data are cross-sectional and cannot inform conclusions about causality. Also, the exploratory design of our analyses maximized the discovery of potentially important associations and, thus, involved a large number of tests and variables. The p-values we report have not been adjusted for these multiple tests and some of the significant associations we report may not be significant in future studies [85]. Also, our personal network design is limited to the respondents' perception of their networks and we cannot know how well the respondents' reports of the behaviors of their networks match their actual behavior. We minimized this limitation by

asking specific questions about specific network members rather than general questions about their networks. Also, some studies of adolescent risk behavior have shown that the perception of behavior of peers is just as influential as their actual behavior longitudinally [86]. Another limitation is that our data are representative of homeless youth who are sexually active in Los Angeles but may not represent the behaviors of homeless youth in other cities. Also, two of our variables, relationship commitment and positive condom attitudes, had somewhat low reliability. These measures were adapted with non-homeless populations, suggesting that future studies should develop measures of these concepts for homeless youth. Finally, the social network measurements we report are only one approach to measuring network composition and structure. Additional research that uses exploratory techniques which ask homeless youth to explain how interactions with members of their social networks affect their risk behavior may help guide methodological choices for future studies that aim to inform the development of social network based interventions.

CONCLUSIONS

Our study suggests the importance of an approach to health behavior based on the ecological model. Both qualitative and quantitative findings suggested multiple levels of influence on unprotected sex of homeless youth, including influences at the individual, partner and relationship levels. Also, both quantitative and qualitative findings suggest that these levels are more important than social network influences on unprotected sex. We also identified multiple levels of influence on whether the unprotected sex was unwanted or not. Interventions that aim to reduce risky sexual behavior of homeless youth should target behavior such as unprotected sex at multiple levels. Our study suggested that the partner/relationship level, which has received limited attention in studies of homeless youth risk behavior, has a strong impact on unprotected sex and should be central to any intervention aiming to reduce HIV risk behavior among homeless youth.

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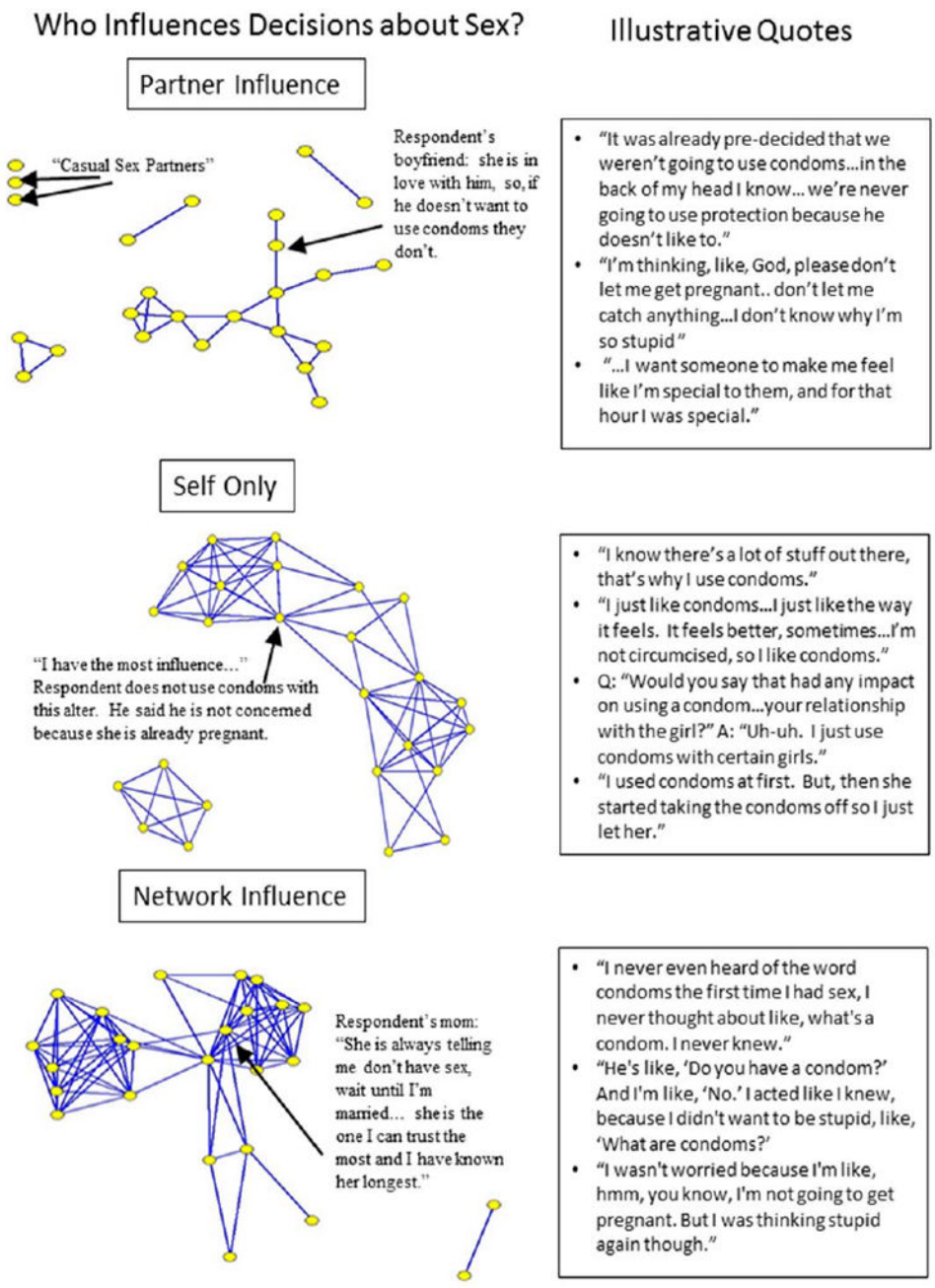

Figure 1.

Three examples of exploratory mixed method analysis of homeless youth social networks with example quotes about their decisions to use condoms during recent sex events. The first example is a female respondent who identified her boyfriend as the person with the most influence over her decisions about sex. She said that she does not use condoms because he does not like them. The middle example is a male respondent who said the he himself has the most influence over his sexual decisions. He does not use condoms with the alter he identified and is not concerned because she is already pregnant. The final example is a female respondent who identified her mother as the most influential over her sexual

decisions because she encourages abstinence. However, the respondent reported having unprotected sex with multiple partners.

Table 1

Individual-Level Descriptive Statistics for Individual Characteristics

	Unprotected Sex (*n* = 240)		Unwanted Unprotected Sex (*n* = 161)	
Variable	**Mean (se)**	**%**	**Mean (se)**	**%**
Respondent biologically male		61.19		56.88
Race				
White/Other		56.28		59.99
Black		25.34		20.9
Hispanic		18.38		19.11
High school degree or GED		52.91		49.43
Income per month	456.02 (46.65)		484.60 (61.74)	
Years homeless	4.59 (.22)		4.71 (.27)	
History of abuse at home		70.13		75.71
Migration experience	2.88 (.45)		2.90 (.54)	
Sexual experiences				
# sex partners in past 3 months	2.29 (.18)		2.14 (.18)	
Tested for HIV		86.11		88.18
Recently pregnant or tried *		25.2		26.46
Recently used birth control *		21.41		22.46
Attitudes toward pregnancy and HIV				
Important to avoid pregnancy	1.60 (.08)		1.62 (.09)	
Upset over pregnancy	2.19 (.08)		2.28 (.10)	
Positive condom attitudes	3.51 (.04)		3.40 (.05)	
HIV perceived susceptibility	12.14 (.19)		11.56 (.23)	

Note.

* Females only, *n* = 93

Table 2

Individual-Level Descriptive Statistics for Social Network Characteristics

	Unprotected Sex (*n* = 240)		Unwanted Unprotected Sex (*n* = 161)	
Variable	**Mean (se)**	**%**	**Mean (se)**	**%**
Network composition				
Alters who attend school regularly				
None		18.05		19.78
1 or 2 alters		29.75		35.30
3 or more		52.20		44.92
Any adult in position of responsibility		22.29		22.96
Family				
None		20.44		22.70
1 or 2		26.97		27.85
3 or more		52.59		49.45
Any alter drink with		80.07		83.97
Any alter drugs with		69.74		72.05
Likely to engage in risky sex				
None		13.28		14.08
1 or 2 alters		30.34		26.77
3 or more alters		56.37		59.14
Any alter met online/phoneline		14.40		15.91
Any alter met at a shelter (non-provider)		46.19		43.82
Any alter met on the street		68.84		72.91
Any alter homeless		88.18		89.97
Proportion of non-partner alters who discuss HIV	0.15 (.02)		.14 (.02)	
Network structure				
Density	.15 (.01)		.14 (.01)	
Centralization	.21 (.01)		.20 (.01)	
Number of isolates	6.22 (.37)		6.57 (.46)	
Size of largest component	9.53 (.39)		9.31 (.49)	
Network structure/ composition				
Risky sex in-group density	.10 (.01)		.11 (.02)	
Risky sex in-group centralization	.10 (.01)		.11 (.01)	

Table 3

Partner and Relationship Level Descriptive Statistics for Main Study Variables

	Unprotected Sex (*n* = 240 respondents, 339 partners)		Unwanted Unprotected Sex (*n* = 161 respondents, 207 partners)	
Variable	**Mean (se)**	**%**	**Mean (se)**	**%**
Outcome variables				
Unprotected sex		61.06		
Unwanted unprotected sex				26.09
Partner characteristics				
Attends school regularly		18.08		11.01
Has a steady job		26.26		23.61
Is homeless		47.63		51.94
Partner riskiness				
Tested negative for HIV		60.94		67.27
Drinks to intoxication		55.35		53.48
Uses drugs		62.93		63.87
Engages in risky sex		30.93		29.03
Communication about protection/risk				
Talked about how to prevent HIV		41.42		47.19
Talked about condoms with partner		62.5		61.58
Relationship quality with partner				
Relationship commitment	2.30(.06)		2.49 (.08)	
Length of relationship (days)	806.54(84.33)		825.94 (1.06)	
Any abuse in the relationship		16.45		20.47
Influence of alcohol/drugs on sex				
Proportion of times used alcohol before/during sex with partner	.30(.03)		.28 (.03)	
Proportion of times used drugs before/during sex with partner	.30(.03)		.33 (.04)	
Partner's network connections				
Degree	2.79(.25)		3.00 (.32)	
Is an isolate		32.87		28.39
Sex type of relationship (respondent-partner)				
Male-male/transgendered		13.22		9.69
Male-female		51.64		50.93
Male-female		34.85		39.38

Table 4

Bivariate Logistic Regression Models With Individual and Social Network Variables Predicting Unprotected and Unwanted Unprotected Sex with a Particular Partner

	Unprotected Sex (*n* = 240 respondents, 339 partners)	Unwanted Unprotected Sex (*n* = 161 respondents, 207 partners)
Variable	***OR* (95% *CI*)**	***OR* (95% *CI*)**
Individual level variables		
History of abuse at home	4.51 (1.01, 20.06) *	3.31 (0.78, 14.07)
Migration experience	1.01 (0.85, 1.19)	0.82 (0.68, 0.99) *
Total partners in past 3 months	0.82 (0.58, 1.18)	1.03 (0.87, 1.21)
Tested for HIV	1.20 (0.15, 9.42)	0.38 (0.07, 2.09)
Recently pregnant [1]	2.39 (0.33, 17.20)	0.57 (0.08, 4.28)
Recent use of birth control [1]	0.78 (0.17, 3.51)	1.50 (0.28, 7.89)
Important to avoid pregnancy	1.29 (0.63, 2.63)	0.88 (0.55, 1.38)
Upset over pregnancy	1.73 (0.82, 3.64)	0.67 (0.40, 1.15)
Positive attitudes towards condoms	0.53 (0.41, 0.71) **	1.25 (1.02, 1.53) *
HIV Attitudes	1.19 (0.55, 2.57)	1.54 (0.88, 2.67)
Social network composition		
Attends school regularly (1-2 vs. 0)	1.02 (0.08, 12.26)	1.26 (0.28, 5.56)
Attends school regularly (3+ vs. 0)	0.14 (0.02, 1.30) †	1.92 (0.46, 8.06)
Any adult in position of responsibility	1.41 (0.26, 7.73)	0.18 (0.04, 0.77) *
Family member alters (1-2 vs. 0)	1.28 (0.14, 11.72)	1.21 (0.22, 6.68)
Family members (3+ vs. 0)	0.78 (0.12, 5.12)	1.88 (0.45, 7.85)
Any drinking partners	6.65 (1.48, 29.96) *	1.93 (0.40, 9.37)
Any drug use partner	2.58 (0.59, 11.21)	2.25 (0.67, 7.55)
Risky sex alters (1-2 vs. 0)	0.26 (0.03, 2.39)	0.55 (0.09, 3.36)
Risky sex alters (3+ vs. 0)	0.93 (0.11, 7.87)	0.70 (0.15, 3.33)
Any alter met online/phone line	1.90 (0.28, 12.87)	0.56 (0.13, 2.49)
Any alter met in shelter	0.89 (0.20, 3.97)	1.63 (0.54, 4.90)
Any alter met on the street	4.08 (0.92, 18.02) #	1.72 (0.48, 6.11)
Any recently homeless alter	6.31 (1.23, 32.43) *	4.55 (0.53, 39.21)
Proportion of non-partner alters who discuss HIV	0.34 (0.01, 9.22)	0.37 (0.03, 4.76)
Social network structure		
Density	.05 (0.00, 9.35)	.06 (.00, 2.34)
Network centralization	.02 (0.00, 4.26)	.06 (.00, 4.59)
Number of isolates	1.09 (0.91, 1.30)	1.02 (.93, 1.13)
Size of largest component	.97 (0.88, 1.07)	.97 (.88, 1.07)
Social network structure and composition		
Risky sex in-group density	1.86 (0.04, 85.62)	.53 (.03, 8.29)
Risky sex in-group centralization	13.62 (0.17,1089.24)	2.86 (.19, 43.07)

Note.

[#] $p < .10$.

[**] $p < .05$.

[*] $p < .01$.

[1] Models were run for female respondents only.

Table 5

Bivariate Logistic Regression Models With Partner and Relationship Level Variables Predicting Unprotected and Unwanted Unprotected Sex with a Particular Partner

	Unprotected Sex (*n* = 240 respondents., 339 partners)	Unwanted Unprotected Sex (*n* = 161 respondents., 207 partners)
Variable	***OR* (95% *CI*)**	***OR* (95% *CI*)**
Partner level variables		
Attends school regularly	0.07 (0.02,0.26) **	0.23 (0.04,1.49)
Has a steady job	0.54 (0.15,1.88)	0.42 (0.07,2.49)
Is homeless	4.27 (0.91,20.01) #	1.37 (0.39,4.84)
Tested negative for HIV	4.84 (1.17,19.99) *	0.24 (0.06,0.94) *
Drinks to intoxication	1.01 (0.26,3.94)	1.47 (0.46,4.71)
Uses drugs	1.45 (0.39,5.36)	1.48 (0.45,4.87)
Engages in risky sex	0.55 (0.13,2.22)	0.73 (0.21,2.57)
Relationship level variables		
Talked about condoms with partner	0.61 (0.16,2.35)	1.06 (0.33,3.42)
Talked about how to prevent HIV	9.75 (1.73,55.10) *	0.13 (0.04,0.51) **
Relationship commitment	10.42 (2.95,36.78) *	0.38 (0.22,0.64) **
Length of relationship (days)	1.00 (1.00,1.00)	1.00 (1.00,1.00)
Any abuse in the relationship	8.53 (1.36,53.59) *	2.20 (0.55,8.79)
Proportion of times used alcohol before/during sex with partner	0.55 (0.12,2.59)	6.25 (1.60,24.42) **
Proportion of times used drugs before/during sex with partner	1.08 (0.23,4.94)	2.00 (0.47,8.52)
Partner's network connections		
Degree	1.26 (1.01,1.57) *	0.96 (0.85,1.09)
Is an isolate	0.36 (0.08,1.63)	1.39 (0.44,4.41)
Sex-type of relationship (respondent-partner)		
Male-male/transgendered (vs. female-male)	0.12 (0.02,0.99) *	2.26 (0.29,17.62)
Male-female (vs. female-male)	0.30 (0.07,1.39)	3.48 (1.06,11.41) *

Note.

# $p < .10$.

** $p < .05$,

* $p < .01$.

Table 6

Multi-level Multivariate Logistic Regression Models Predicting Unprotected and Unwanted Unprotected Sex With a Particular Partner

	Unprotected Sex (*n* = 240 respondents, 339 partners)	Unwanted Unprotected Sex (*n* = 161 respondents, 207 partners)
Variable	***OR* (95% *CI*)**	***OR* (95% *CI*)**
Individual characteristics		
Migration experience		0.79 (0.62, 1.00) **
Lifetime experience of abuse	5.63 (1.31, 24.29) **	
Positive attitudes about condoms	0.50 (0.35, 0.69) **	1.29 (1.04, 1.59) **
Social network characteristics		
Alters attend school regularly (1-2 vs. none)	0.57 (0.06, 5.68)	
Alters attend school regularly (3+ vs. none)	0.22 (0.02, 2.03)	
Any adult alter in position of responsibility		0.11 (0.02, 0.57) **
Any drinking partner alters	1.70 (0.29, 9.83)	
Any alters met on the street	1.21 (0.23, 6.36)	
Any recently homeless alters	2.62 (0.38, 17.92)	
Partner characteristics		
Partner attends school regularly	0.16 (0.03, 0.82) **	
Partner is homeless	0.70 (0.15, 3.33)	
Partner Tested Negative for HIV	1.58 (0.45, 5.53)	0.50 (0.11, 2.17)
Relationship characteristics		
Talked with about how to prevent HIV	2.70 (0.74, 9.86)	0.18 (0.04, 0.75) **
Relationship commitment	6.70 (2.71, 16.61) **	0.61 (0.34, 1.12)
Abuse within the relationship	2.21 (0.50, 9.74)	
Partner's network connections (degree)	1.01 (0.85, 1.19)	
AOD use in combination with sex		
Drinking before/during sex with partner		2.70 (0.66, 11.06)
Sex-type of relationship (respondent-partner)		
Male-male/transgender (vs. female-male)	0.18 (0.02, 1.73)	1.49 (0.27, 8.32)
Male-female (vs. female-male)	0.65 (0.12, 3.58)	2.34 (0.61, 8.99)

Note.

* $p < .05$,

** $p < .01$. Both models control for race/ethnicity, education, income, and total years homeless.