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ORIGINAL PAPER

Role of Social Network Sexual Norms and Behaviors on the HIV Sexual Risk Behaviors of People Who Inject Drugs in HPTN 037

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Abstract

This study examined the effect of social network descriptive sexual norms and behaviors on the sexual behaviors of people who inject drugs (PWID). Data from HPTN037 of 232 PWID (egos) and 464 network members (alters) were used in multilevel multivariate logistic regression models. Egos whose alters reported multiple sex partners had greater odds of multiple sex partners (aOR 2.20, 1.13–4.29). Egos' norms of condomless sex with primary (aOR 2.67, 1.15–6.17) and casual (aOR 2.38, 1.01–5.59) partners and egos' norms of giving (aOR 5.52, 1.87–16.25) and receiving (aOR 7.38, 1.34–40.66) money/drugs for sex were associated with the egos' respective behaviors. History of sex between an ego and alter was not associated with increased influence of alters' norms and behaviors on egos' sexual behavior. Findings provide support for developing interventions that target descriptive norms and selective network behavioral characteristics to decrease sexual HIV risk behavior among PWID.

Keywords People who inject drugs · Sexual risk behavior · HIV · Social norms · Social networks

Introduction

Human immunodeficiency virus (HIV) diagnoses among persons who inject drugs (PWID) declined 48% from 2008 to 2014 [1]. The decline can be attributable, in part, to a significant drop in syringe sharing among black and Latino PWID. From 2005 to 2015, self-reported syringe sharing declined 34% and 12% among black and Latino PWID in the United States (US), respectively [1]. Nevertheless, PWID continue to be at high risk for HIV acquisition through sexual risk behavior [1]. Substantially less attention has been given to developing evidence-based interventions for sex-related risk behaviors than for drug-related risk behaviors among PWID, and to testing these interventions through robust randomized controlled trials [2]. Research suggests that reducing drug-related risk behaviors among PWID is not always associated with reductions in sex-related risk behaviors [3]. Thus, innovative approaches are needed for addressing sexual risk behaviors among PWID.

Social networks are connections among people, and social network analyses propose that the attributes of people in a network influence an individual's behavior above and beyond the influence of their own attributes [4]. Further, social network analysis takes into account relational characteristics (those about a set of direct ties) and structural characteristics (those about an entire network) such as how well people know each other or the influence they have in a network [4]. Egocentric social network refers to an individual's (ego's) personal network and is concerned with the effect of network members (alters) on the ego's behavior [5]. Previous studies indicate that social networks are particularly important in HIV transmission for PWID [6–9] and that network characteristics, including high-risk drug- and sex-related social norms, are associated with PWID's

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high-risk behaviors [10–13]. Social norms theory posits that individual's behaviors are influenced by perceptions of peer attitudes and behaviors [14]. In relation to social networks, descriptive norms refer to an ego's perception of how their alters act, while injunctive norms refer to an evaluative judgment, usually whether alters approve or disapprove of a behavior [14]. Interventions to change these perceptions may result in positive behavior change, including among PWID [15, 16]. Social network research among PWID has tended to focus on the drug-using behaviors and norms of alters, and the sexual behaviors of alters [7–9, 11, 13, 17]. Studies have further focused on ego's drug and sexual norms (e.g., ego's perception of how others think or act) [8, 18, 19]. However, there is a paucity of research about the sexual norms of alters among networks of PWID.

The current study examined egocentric social networks in the context of sexual risk norms and behaviors among PWID in Philadelphia. About 5% of the population 12 years and older in Philadelphia reports illicit drug use other than marijuana [20]. In 2015, injection drug use accounted for 5.5% of new HIV cases in Philadelphia and this number has decreased since 2010 (10%) [20]. However, the rate of new HIV infection in Philadelphia continues to be high (2017: 25.2 per 100,000 population) [21]. The objective of this study is to examine the effect of egocentric social network descriptive sexual norms and behaviors on the HIV sexual risk behaviors of people who inject drugs (PWID). Based on social norms theory, we hypothesized that egos who endorse high-risk sexual norms, those who have alters that endorse high-risk sexual norms, and those who have alters who report high-risk sexual behaviors would be more likely to report high-risk sexual behavior. We further hypothesize that alters who have a previous sexual relationship with an ego will have a stronger influence on the ego's sexual behavior.

Methods

Parent Study

The current study was conducted using data from HIV Prevention Trials Network (HPTN) 037—a phase three randomized controlled trial designed to test the efficacy of a network-oriented peer education intervention for preventing HIV transmission among PWID. The HPTN 037 study was implemented in Philadelphia, USA, and Chiang Mai, Thailand, and approved by the affiliated Institutional Review Boards in both countries. The protocol, including intervention details, is described elsewhere [22]. The current study utilized de-identified baseline data from the Philadelphia site only and was deemed non-human subjects research by the local IRB.

Participants

The parent trial enrolled index participants (egos) and members of their HIV risk networks (alters). Egos that were HIV negative were actively recruited by study staff from areas in Philadelphia with high HIV and injection drug use prevalence. Subsequently, egos recruited individuals with whom they had injected drugs or had sex within the prior 3 months. To be eligible, egos had to be ≥ 18 years of age, report injecting drugs at least 12 times in the last 3 months, test negative for HIV, not be enrolled in medication-assisted treatment for opioid dependence in the past 3 months, and recruit at least one member from their injection and/or sexual risk network into the study. Alters had to be ≥ 18 years of age, be recruited by an eligible ego, and report injecting drugs with or have had sex with the ego within the prior 3 months.

Measures

Individual-Level Measures

Five sexual risk behaviors ("sexual risk behaviors" in this study refers to sexual behaviors that increase individuals' risk for HIV. Of note, this study was conducted prior to the availability of pre-exposure prophylaxis) were examined in the current study: (1) sex with multiple partners ("In the last month, how many different female [or male] sex partners did you have?"); (2) sex with a primary partner without a condom ("In the last week, how many times did you have vaginal or anal sex with your primary sex partner?" and "How many of these times did you, or your partner, use a condom?"); (3) sex with a casual partner without a condom ("In the last week, how many times did you have vaginal or anal sex with someone other than your primary sex partner?" and "How many of these times did you, or your partner, use a condom?"); (4) giving money/drugs for sex ("In the last month, how many sex partners did you give money or drugs to in exchange for sex?") and (5) receiving money/drugs for sex ("In the last month, how many sex partners gave you money or drugs in exchange for sex?"). Behaviors were coded as 1 ("yes risky behavior") if they reported the behavior, or 0 ("no risky behavior").

Five descriptive sexual risk norms corresponding to the five sexual risk behaviors described above were examined. Descriptive versus injunctive norms were chosen because we had sexual risk behavior data that closely corresponded with each descriptive norm and because descriptive norms have shown to be more strongly associated with sexual behavior when compared with injunctive norms [23].

Norms were assessed by asking participants their perception of the people they know or hang out with (not specifically the alters) through the following questions: "How many of your friends have sex with more than one person?"; "How many of your friends use condoms all the time with their primary partner?"; "How many of your friends use condoms all the time with their casual or occasional partners?"; "How many of your friends pay others for sex?"; and "How many of your friends trade sex for money or drugs?". Responses were provided on a 5-point Likert scale ("none"; "some"; "about half"; "most"; and "all"). To maintain similar measurement scales between the individual- and network-level norms and for ease of interpretation, we dichotomized the 5-point Likert scale responses. The norms of multiple partners and exchange of money/drugs and sex were dichotomized by grouping those who perceived that "some", "about half", "most", or "all" of their friends exhibit the behavior and coding their responses to 1 ("yes risky norm") and coding those who perceived that "none" of their friends exhibited the behavior as 0 ("no risky norm"). Because of the reverse wording of the condom use norms, we grouped those who perceived that "none", "some", "about half", and "most" of their friends use condoms all the time as 1 ("yes risky norm") and coded those who perceived that "all" of their friends use condoms all the time as 0 ("no risky norm"). Additional covariates for the current study included self-reported sex, age, race, marital status, educational attainment, and whether the ego and alter reported ever having sex with each other. Sexual behaviors that were missing a response, and norms that were missing a response or responded to as "don't know" were coded as 0 ("low-risk") assuming no risk as in a previous study [13].

Statistical Analysis

Analyses were performed using SAS software version 9.4 (SAS Institute, Cary, NC 2002). We conducted descriptive statistics and compared demographics, behaviors, and norms between egos and alters using Chi square tests for independence for categorical variables and t-tests for continuous variables. We estimated adjusted odds ratios (aORs) and 95% confidence intervals (CI) for each of the five behaviors using PROC GLIMMIX. Multilevel logistic regression models were used to account for clustering of alters by ego [4]. To estimate the odds of egos reporting each of the five sexual behaviors, we first estimated odds ratios adjusting for sex, age, race, marital status, and educational attainment (Model 1). Second, we added to the model whether the ego and alter reported ever having sex (Model 2). Finally, we added an interaction term for ever having sex and alters' sexual behavior (Model 3) and in a separate model an interaction term for ever having sex and alters' sexual norms (Model 4). Bivariate associations between missing data on each sexual behavior and norm and demographic characteristics (gender, age, race, marital status, and education attainment) were evaluated. Sensitivity analyses were conducted by excluding egos and alters with missing values and running models to identify changes between models with and models without missing data.

Results

Characteristics of Egos and Alters

Of 232 PWID egos, the majority were male (79.7%) and single (72.4%) (Table 1). The median age was 41 years old (range 19–65). Most egos were non-Latino white (50.4%) or non-Latino black (43.5%), and 6.0% were of other race; most were non-Latino ethnicity (94.0%). Alters were similar to egos in demographic characteristics except that a smaller proportion were male (63.4%; p-value <0.0001).

Regarding sexual behaviors, over forty percent of egos reported having sex with multiple partners in the last month (43.1%). A larger proportion of egos reported no condom use with casual partners (64.7%) than with primary partners (56.0%) in the prior week. Additionally, 21.1% reported exchanging money or drugs for sex and 14.7% reported exchanging sex for money or drugs. Alters were similar to egos in terms of sexual behaviors except that a smaller proportion of alters reported giving money or drugs for sex (13.6%, p-value 0.0107).

Regarding descriptive norms, the majority of egos perceived that their friends have sex with multiple partners (86.6%) and that they do not use condoms with primary (71.6%) or casual partners (72.8%). Over half of egos perceived that their friends exchange money or drugs for sex (56.0%) or sex for money or drugs (69.8%). Alters were significantly different from egos in all sexual norms. A smaller proportion of alters reported that their friends have sex with multiple partners (63.2%, p-value <0.0001), do not use condoms with primary (58.2%, p-value 0.0006) and casual partners (61.2%, p-value 0.0024), and receive money or drugs for sex (46.8%, p-value 0.0212). A larger proportion of alters reported that their friends give money or drugs for sex (59.7%, p-value 0.0090).

Findings from Model 1 (controlling for sex, age, race, marital status, and educational attainment) and Model 2 (controlling for covariates in Model 1 plus whether the ego and alter had a history of having sex with each other), did not differ (Table 2). Alters' behavior of sex with multiple partners was associated with a twofold increased odds of sex with multiple partners among egos (aOR 2.20, 95% CI 1.13–4.29). For the behaviors of condom use and the exchange of money/drugs for sex, only ego's norms, not

Table 1 Characteristics of egos and alters in the HPTN 037 randomized controlled trial

Characteristic	Egos (N = 232)		Alters (N = 464)		*p*-value
	%	Median (range)	%	Median (range)	
Demographics					
Male sex	79.7		63.4		< 0.0001
Age		41 (19–65)		41.0 (18–70.0)	0.4639
Black race	43.5		49.6		0.1329
Single marital status	72.4		74.2		0.6268
Education less than high school	32.8		34.3		0.6916
Sexual risk behaviors					
Multiple partners (> 1)	43.1		39.0		0.2993
No condom use with primary partner	56.0		48.3		0.0536
No condom use with casual partner	64.7		62.7		0.6166
Giving of money or drugs for sex	21.1		13.6		0.0107
Receiving money or drugs for sex	14.7		18.8		0.1790
Perceived Sexual risk norms					
Friends have sex with multiple partners	86.6		63.2		< 0.0001
Friends do not use condoms with their primary partner	71.6		58.2		0.0006
Friends do not use condoms with casual partners	72.8		61.2		0.0024
Friends give money or drugs for sex	56.0		59.7		0.0090
Friends receive money or drugs for sex	69.8		46.8		0.0212

alters' behaviors or norms, were associated with their behavior. Egos who perceive that their friends do not use condoms with their primary (aOR 2.67, 95% CI 1.15–6.17) or casual (aOR 2.38, 95% CI 1.01–5.59) partners, had increased odds of reporting no condom with their primary or casual partners, respectively. Egos who perceive that their friends give (aOR 5.52, 95% CI 1.87–16.25) or receive (aOR 7.38, 95% CI 1.34–40.66) money or drugs for sex, had increased odds of reporting giving or receiving money or drugs for sex. There was no interaction between ever having sex and alters' sexual behavior (Model 3), nor for ever having sex and alters' sexual norms (Model 4).

Analyses of Missing Data

Among egos, 19–36% were missing data on sexual risk behaviors depending on the specific behavior and 4–24% were missing data on norms depending on the specific norm. Only gender and marital status were associated with missing data among egos; wherein males (p-value = 0.0408) and single individuals (p-value < 0.0001) were more likely to have missing data on condom use with primary partners. This is likely due to males being more likely than females to be single (77.0% vs. 65.9%; p-value < 0.0020) and questions left blank for people who did not have a primary partner.

Among alters, 28–46% were missing data on sexual risk behaviors, and 19–38% were missing data on norms depending on the norm. Males were more likely than females to have missing data on all sexual behaviors (p-value < 0.0001). Alters 50 years or older (p-value 0.0145) and those who were single (p-value 0.0011) were more likely to have missing data on sex without a condom with primary partners. Males (p-value 0.0105), blacks (p-value 0.0307), and alters who were not single (p-value 0.0302) were more likely to have missing data on the norm of sex with multiple partners. Alters 50 years or older (p-value 0.0283) and blacks (p-value 0.0047) were more likely to have missing data on the norm of sex without a condom with primary partners. Finally, alters who were married were more likely to have missing data on the norm of sex without a condom with casual partners ((p-value 0.0451).

Findings from our fully adjusted model (Model 2) did not change when we excluded missing values, with the exception of losing significance in our association between ego's norms of receiving money/drugs for sex and their behavior of receiving money/drugs for sex (aOR 4.97, 95% CI 0.54–45.53).

Discussion

Our study has three primary findings. First, egos' perceptions of their friends' behaviors (norms) were associated with their own sexual behavior for condom use with primary and casual partners, as well as for giving and receiving money or drugs for sex. Second, alters' behavior of sex with multiple partners was associated with egos behavior of sex with multiple partners, but not for condom use or the

Table 2 Association between egos' sexual behavior and egos' norms, alters' sexual behavior, and alters' sexual norms in the HPTN 037 randomized controlled trial

	Model 1	Model 2
Outcome: Egos' report of multiple partners		
Ego's norm: Friends have sex with multiple partners		
No	Ref.	Ref.
Yes	3.12 (0.94–10.4)	3.13 (0.94–10.42)
Alter's behavior: Multiple partners		
No	Ref.	Ref.
Yes	2.27 (1.18–4.38)	2.20 (1.13–4.29)
Alter's norm: Friends have sex with multiple partners		
No	Ref.	Ref.
Yes	0.84 (0.41–1.72)	0.844 (0.42–1.72)
Outcome: Egos' report of no condom use with primary partner		
Ego's norm: Friends do not use condoms with their primary partner		
No	Ref.	Ref.
Yes	2.61 (1.13–6.01)	2.67 (1.15–6.17)
Alter's behavior: No condom use with primary partner		
No	Ref.	Ref.
Yes	1.64 (0.87–3.09)	1.42 (0.74–2.72)
Alter's norm: Friends do not use condoms with their primary partner		
No	Ref.	Ref.
Yes	1.00 (0.52–1.92)	0.95 (0.49–1.84)
Outcome: Egos' report of no condom use with casual partner		
Ego's norm: Friends do not use condoms with casual partners		
No	Ref.	Ref.
Yes	2.39 (1.02–5.59)	2.38 (1.01–5.59)
Alter's behavior: No condom use with casual partner		
No	Ref.	Ref.
Yes	1.73 (0.91–3.31)	1.57 (0.81–3.05)
Alter's norm: Friends do not use condoms with casual partners		
No	Ref.	Ref.
Yes	0.92 (0.47–1.80)	0.91 (0.46–1.78)
Outcome: Egos' report of giving money or drugs for sex		
Ego's norm: Friends give money or drugs for sex		
No	Ref.	Ref.
Yes	5.46 (1.86–16.02)	5.52 (1.87–16.25)
Alter's behavior: Giving money or drugs for sex		
No	Ref.	Ref.
Yes	1.35 (0.45–4.06)	1.38 (0.46–4.17)
Alter's norm: Friends give money or drugs for sex		
No	Ref.	Ref.
Yes	0.97 (0.43–2.21)	1.01 (0.44–2.31)
Outcome: Egos' report of receiving money or drugs for sex		
Ego's norm: Friends receive money or drugs for sex		
No	Ref.	Ref.
Yes	7.41 (1.34–40.97)	7.38 (1.34–40.66)
Alter's behavior: Receive money or drugs for sex		
No	Ref.	Ref.
Yes	1.72 (0.58–5.12)	1.63 (0.53–4.95)
Alter's norm: Friends receive money or drugs for sex		
No	Ref.	Ref.
Yes	0.86 (0.33–2.26)	0.86 (0.33–2.24)

Model 1: adjusted for sex, age, race, marital status, and educational attainment

Model 2: adjusted for sex, age, race, marital status, educational attainment, and sexual relationship between ego and alter

exchange of money or drugs for sex. Finally, history of sex between an ego and alter was not associated with increased influence of alters' norms and behaviors on egos' sexual behavior.

Consistent with previous studies [23–27], egos' norms were associated with their sexual behavior, except for sex with multiple partner behavior. A recent study of 702 young black men that examined several contextual determinants of sexual behavior, including gender norms, environment, peers, and family, found that only sexual risk peer norms were associated with their sexual risk behavior of multiple partners and sex without a condom [24]. Further, a study of substance-using Latinos found that participants with perceived peer norms encouraging safer sex were less likely to engage in inconsistent condom use and have multiple partners [25]. Similar findings have been suggested with risky drug use. A study of two sociocentric networks of homeless youth found an association between descriptive and injunctive drug-related norms and drug use behavior [28]. Perceived peer norms may be a reflection of self-efficacy. A study that examined pathways to HIV sexual risk reduction among heterosexual people who inject drugs found that among women, safer sex peer norms predicted higher self-efficacy, partially measured as the person's confidence in their ability to control sexual risk-taking, and in turn higher self-efficacy predicted stronger commitment to safer sex [26]. Norms may also be a reflection of previous sexual risk behavior, as suggested by a longitudinal study that found safe sex to predict past, but not future behavior [27]. Contrary to our hypothesis alters' sexual norms were not associated with any of the 5 sexual risk behaviors examined among egos. This may be due to the design of our study, wherein alters' networks may differ significantly from egos' network.

Alters' behavior of sex with multiple partners was associated with egos multiple partner behavior. The alters' behaviors of sex without a condom with primary and casual partners and of giving and receiving money or drugs for sex were not associated with egos' behaviors. A study examining the egocentric networks of 75 men who have sex with men found a correlation between alters' behavior of unprotected sex and giving or receiving money or drugs for sex and egos corresponding behaviors [29]. Further, consistent with social norms theory, our study's post hoc analyses revealed a weak correlation between egos' perception of their friends' behavior and the behavior of their alters (Pearson correlation: 0.10–0.23). Together, these findings suggest that interventions to change perceived sexual norms [14–16] may result in behavior change among PWID. A study of 59 networks of men in Tanzania found significant clustering of sexual risk norms and behaviors, including condom use [12]. Thus, there is potential utility and efficiency in interventions that address misperceived norms through group-level strategies to decrease sexual risk behavior of sociocentric networks.

History of sex between an ego and alter was not associated with increased influence of alter's norms and behaviors on ego's sexual behavior. Our finding is consistent with a study of black men who have sex with men that found an association between social network alter's norms and ego's behavior of unprotected anal intercourse, but not for alters in the ego's sexual network [30]. In our study, alters were eligible to participate if they had a history of injecting drugs with or having sex with the ego. However, a social support tie with the ego was not necessary or evaluated. It is possible that social support networks, compared with drug/sex networks, are more influential. Research suggests that overlap between sexual and social networks vary and may be greater in some areas such as those that are rural, and that this overlap may serve as a bridge into the HIV epidemic in the general population [31].

The current study has several important limitations. First, the composition of networks was influenced by egos, mainly by whom they identified to be recruited and whether that alter chose to participate. Related, it was not feasible to identify or recruit all members of an ego's network, and thus our study is limited to examining partial egocentric networks. Second, due to limitations of the sample size, both norms and behaviors were dichotomized into two risk groups, and missing data was coded as no/low-risk. The proportion of missing data among egos and alters in our study is consistent with other social network studies of PWID [9]. Nevertheless, sensitivity analysis did not reveal major differences between missing data and outcome behavior or the association between behaviors and norms. Finally, egos were asked about their perceptions of the behaviors of their friends in general and not specifically about the alters enrolled in the study. Our study only included dyadic data for the history of sex between the ego and alter. Future network research should consider examining the contribution of the moderating effect of network structural (i.e., size), functional (i.e., relationship type) and interactional (i.e., closeness) characteristics on the effect of sexual risk network norms and behaviors [8, 11, 13, 32–34].

Conclusions

Findings provide support for developing interventions that target perceived norms and selective egocentric network behavioral characteristics to decrease risky sexual behavior among PWID. This study underscores the importance of sexual norms on the HIV sexual risk behaviors of PWID. More research is needed to develop evidence-based interventions that address sexual norms and perceptions of peer behavior among PWID. Finally, more research is needed to understand the distinct influence of sexual versus other types

of social support network members that may be necessary to tailor interventions.

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Compliance with Ethical Standards

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

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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

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