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Predictors of Willingness to Diffuse PrEP Information within Ego-Centric Networks of Women Who Inject Drugs

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Abstract

Little is known about how social networks among women who inject drugs (WWID) can be leveraged to increase awareness about pre-exposure prophylaxis (PrEP). We tested the hypothesis that interpersonal characteristics influence willingness of WWID to communicate PrEP information with peers. Forty WWID ≥ 18 years completed social network surveys. Participants named on average 9.3 (SD = 3.3) network members, resulting in 375 unique relationships. WWID were willing to share PrEP information with 83% of network members. Participants had higher odds of willingness to share information within relationships when the network member was female, homeless and perceived to be at risk for HIV. Among relationships with family members and transactional sex clients, stronger emotional closeness was associated with higher odds of willingness to share information. Peer interventions where WWID share PrEP information with peers may be an efficient approach to increase PrEP awareness among this vulnerable population.

Keywords

Interpersonal communication; HIV prevention; Women who inject drugs; Peer support

Introduction

In North America, an estimated 2.5 million people have injected drugs (PWID) in the previous year, 30% (766,000) of whom are women [1]. While new HIV diagnoses among PWID in the United States (US) dropped dramatically from 40% in the 1990s to 6% in 2017 [2], injection drug use fuelled by the opioid crisis has been associated with HIV outbreaks

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across the country [3–6]. Women who inject drugs (WWID) are particularly at risk for HIV given difficulties negotiating the use of harm reduction supplies, such as condoms and sterile syringes, with male partners [7, 8]. This suggests an urgent need to scale programs that arm at-risk WWID with woman-controlled HIV prevention tools, such as daily oral pre-exposure prophylaxis (PrEP) [9].

Despite its immense promise, WWID remain largely unaware of PrEP [10–12] and therefore have little opportunity to benefit from this medication. While efforts to increase WWID's awareness about PrEP are clearly needed [13–15], traditional strategies, such as education sessions during medical appointments, are suboptimal for reaching WWID given their limited engagement with traditional health-care systems [16–18]. Innovative approaches are therefore needed to deliver PrEP information to WWID. One such approach may be to leverage social networks, such as by having WWID deliver information about PrEP to peers in their social networks. This has been an effective approach to increase awareness and utilization of other HIV prevention methods (i.e. use of condoms) [19–24], which suggests a similar approach could be used to promote PrEP among WWID.

Research suggests that individuals from vulnerable populations (e.g., men who have sex with men) are willing and interested in sharing PrEP information with people they know [25, 26]. However, little is known about with which network members (e.g. friends, romantic partners etc.) these individuals would be willing to share PrEP information. Knowing this is important because outcomes from peer-delivered HIV interventions focusing on other harm reduction approaches among PWID show differential information spread among network members by relationship type [21, 22, 27]. For example, information tends to be delivered to friends and people who use drugs, but rarely to sex partners [21, 28]. This suggests that that not all relationships are conducive to the sharing of intervention information, and that peer-led information diffusion interventions would benefit from a deeper understanding of the characteristics of relationships that facilitate or challenge the interpersonal communication of HIV-related information.

To understand how and why information may be communicated within relationships, research often focuses on three elements known to influence interpersonal communication: social relations, similarities, and interactions [29]. (1) *Social Relations* reflects the type of social connection two people share, such as the social role (e.g. kin, friend, etc.) and emotional closeness [30]. For example, Roberts and Dunbar (2011) show that among social networks of 251 women, relationships characterized by higher emotional closeness communicate more frequently. This association was moderated by social role, whereby the effect of emotional closeness on communication frequency was greater for kin than for friends [31]. (2) *Homophily* refers to the extent to which people share attributes, such as being of the same sex. The more similar people are, the more likely they are to communicate [32]. (3) *Interactions* refer to the series of interchanges that occur within relationships, such as what individuals do together (e.g. have sex) and relationship length. For example, relationship length has been positively associated with communication about sexual health topics, such as HIV status disclosure [33].

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This study uses a social network approach to identify the degree to which characteristics of relationships influence WWID's willingness to share PrEP information with social network members. We hypothesized that social relations, similarities and interactions within relationships influence willingness to share PrEP information. Additionally, given that emotional closeness influences communication differently given the specific social role [31], we hypothesize that there will be an interaction between emotional closeness and social role such that when there is higher emotional closeness within relationships, women will have increased willingness to share information.

Methods

Sample

Participants were recruited from a PrEP demonstration project assessing barriers and facilitators to PrEP engagement when clinical care was provided to 95 WWID within a community-based syringe services program (SSP) in Philadelphia. Participants were HIV-negative English-speaking cisgender females, 18 years or older, who were eligible for PrEP based on CDC clinical guidelines [34] and were offered a PrEP prescription. To be eligible for the present study, women had to be enrolled in the PrEP demonstration project and answer affirmatively to the following baseline question: *Would you be willing to talk to someone you know about PrEP, such as telling someone what PrEP is? This could include a friend, a sex partner, family member* etc. Recruitment for the present study occurred sequentially, based on examination of the baseline question.

Data Collection

Baseline data about participant characteristics was obtained from the PrEP demonstration project baseline survey. To collect the social network data, one interviewer administered a Qualtrics survey via an iPad, conducted in a private space at the SSP. All participants received a $20 gift card incentive for completing the interview which was approximately one hour. Research was approved by the institutional review boards at Drexel University and Prevention Point Philadelphia. Because we describe the study sample in terms of participants as well as their social network members (hereafter referred to as "alters") we use the letter "n" to designate sample size related to participants, and "m" to designate sample size related to alters.

Measures

Participant-Level Data—Participant-level data include socio-demographic characteristics such age (measured in years), race (categorized as *non-Hispanic White, non-Hispanic Black* or *Other*), home-lessness (yes/no), engagement in transactional sex in the last 6 months (yes/no) and whether participants accepted a PrEP prescription in the demonstration project (yes/no). Self-perceived HIV risk was measured on a 5-point Likert scale ranging from extremely unlikely to extremely likely to acquire HIV. Due to small cell sizes, HIV risk was dichotomized to *extremely/very likely* or *extremely/very unlikely/neutral* for analysis.

Network Instrument—Social networks were delineated using a set of name generating questions to elicit up to 20 network members with whom participants have interacted in the

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past 6 months, which included: 5 people with whom participants discussed important matters; 5 people with whom participants have had sex; 5 people with whom participants injected drugs; and 5 women who inject drugs. Socio-demographic characteristics of alters, as reported by participants, included age (in years), gender (answer choices *male, female, trans male or trans female*), and race/ethnicity (answer choices *non-Hispanic White, non-Hispanic Black and non-Hispanic other*).

S*ocial relations* were assessed by eliciting: the main relationship type with each alter (e.g. *acquaintance, family member, main romantic partner*, etc.), emotional closeness (scale from 0–10, where 0 is *no closeness* and 10 is *high closeness*), trust (scale 0–10, where 0 is *no trust* and 10 is *high trust*), and frequency of verbal and physical arguments (answer choices *never, rarely, often, or always*) [35], and whether or not the participant thinks the alter currently is homeless, injects drugs, engages in transactional sex, and takes PrEP. We also assessed perceptions of alters' HIV status (answer choices *HIV positive, negative or unsure*), HIV risk (answer choices *none, low, medium and high*, later dichotomized *to medium/high* and *none/low*) and interest in taking PrEP (Likert scale 1–7 where 1 indicated *no interest* and 7 *highly interested*).

Homophily was measured with a set of variables indicating whether or not each participant/alter dyad were of the same race, gender, and if they both engaged in transactional sex or injection drug use. A variable was generated to assess age differences between the participant and alter by subtracting participant age from alter age. Geographic distance was assessed by asking, "*How far do you live from [alter x]*" (answer choices *within my same neighborhood* or *outside my neighborhood*).

Social interactions were assessed by asking participants if they have had sex or shared injection drug equipment with each alter, both within the last 6 months. Frequency of interaction was measured with, "*How often do you talk with or see each of the people you have listed?*" (answer choices *multiple times a week or monthly/less frequently*). Length of relationship was also assessed (in years).

The primary outcome of interest is willingness to share PrEP information within each dyad. To assess this, participants were presented with the following prompt:

Let's pretend that we developed a program where we trained and paid women to spread information about PrEP to people who they know. For example, tell them what PrEP is, what it does, and where they could go to access it. We are interested in knowing who you would be willing to give information about PrEP to. It is OK to be willing to give information to some but not all people.

Participants were then asked of each alter, "*Would you be willing to give information about PrEP to [alter x]?*" (answer choices *no/yes*).

Analysis—Analyses were performed using STATA version 14 [36]. Descriptive statistics were constructed to examine participant, alter and relationship-level summary measures. Logistic generalized estimating equations (GEE) models were used to examine the bivariate relationship between each predictor variable and the primary outcome of willingness to

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share PrEP information within each relationship, with the participant-alter dyad being the unit of analysis. GEE was used to account for the correlated nature between participants and alters that is inherent in social network data. Next, a multivariable logistic GEE model was fit using purposive model selection [38]: first, variables from bivariate analyses significant at the a priori significance level of $p = 0.20$ were included simultaneously in a single model [38]. Because alter gender and gender homophily conceptually measured the same construct, only gender homophily was included in the multivariable model. Next, variables significant at $\leq p = 0.10$ were retained for the final model. Finally, an interaction between emotional closeness and relationship type was examined using a product term to evaluate our a priori hypothesis that higher emotional closeness would increase willingness to share PrEP information across relationship types.

Results

Participant, Alter and Relational Characteristics

Table 1 shows that participants (n = 40) were predominately White (54%, n = 20) with a mean age of 40.1 (SD ± 9.3), and 60.0% were currently homeless (n = 24). Half (47.5%, n = 19) perceived themselves to be at high risk for HIV, and almost all accepted a PrEP prescription through the demonstration project. The forty WWID named a mean of 9.3 network members (SD ± 3.3) for a total of 375 dyads. Table 2 shows that alters (m = 375) were mostly female (63%, m = 237) and White (54%, m = 203). The most frequently reported alter relationships were friends (36%, m = 133) and acquaintances (23%, m = 87), and participants usually interacted with alters daily or multiple times per week (72%, m = 271). About one-third of alters (34%, m = 126) were homeless, and half (51%, m = 186) of alters were perceived to be at risk for HIV.

Predicting Willingness to Diffuse PrEP Information within Dyads

WWID were willing to share PrEP information with 83% (m = 312) of alters (Table 2). WWID had increased odds of willingness to share PrEP information with alters who were homeless (UOR 3.3, 95% CI 1.5–7.6), injection drug users (UOR 2.3, 95% CI 1.1–4.7), engaged in transactional sex (UOR 4.5, 95% CI 1.6–12.5), and those perceived to be at high risk for HIV (UOR 1.1, 95% CI 1.1–1.2). Related to interpersonal attributes, participants had increased odds of willingness to share PrEP information with alters of the same gender (UOR 5.8, 95% CI 2.5–13.6) and lower odds of willingness to share PrEP information as the relationship length increased (UOR 0.5, 95% CI 0.3–1.1).

In the multivariable model (Table 2), participants had significantly higher odds of willingness to share PrEP information with alters who were of the same gender (adjusted odds ratio [AOR] 3.7; 95% CI 1.2–11.6), homeless (AOR 2.8; 95% CI 1.0–7.5), and those perceived to be at risk for HIV (AOR 4.2; 95% CI 1.6–11.1). As the relationship length with the alter increased, participants had decreased odds of being willing to share PrEP information (AOR 0.9; 95% CI 0.9–0.9). Given the previous literature [31], we tested the hypothesis that increasing levels of emotional closeness may heighten willingness within different relationship types via an interaction term. The interaction term was positive and significant for closeness among family members (AOR 1.9; 95% CI 1.1–3.4) and closeness

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among transactional sex clients (AOR 1.7; 95% CI 1.1–2.8; see Fig. 1 for an interaction plot of results). Among family members and transactional sex clients, decreasing emotional closeness was associated with lower odds of willingness to share PrEP information, and stronger emotional closeness was associated with higher odds of willingness to share PrEP information.

Discussion

This study found that interpersonal characteristics such as similarities, social relations, and interactions were important predictors of willingness to share PrEP information within dyads. Additionally, emotional closeness increased odds of willingness to share PrEP information among transactional sex clients and family members, but not other relationship types. Taken together, findings support our primary hypothesis and partially support our secondary hypotheses. This analysis provides insight into the types of relationships with whom WWID may share PrEP information in the context of a peer intervention. Findings should be used to guide the design and evaluation of a peer intervention to educate WWID about PrEP, which has been sorely lacking to date.

In this study, we measured a variety of interpersonal factors to identify their associations with willingness to share PrEP information. We found that half of alters elicited were perceived to be at risk for HIV, and perceiving a network member to be at risk for HIV was associated with increased odds of willingness to share PrEP information. Thus, a peer intervention where WWID share PrEP information with peers may be an effective strategy to increase awareness of PrEP among network members perceived to be at risk for HIV. More information about how WWID appraise risk of network members is needed to ensure people at objective risk for HIV are receiving the intervention information. This is important because studies show that risk perceptions are complex, and shaped by variables such as race [39], gender [40], and the context of relationships with sexual partners [41, 42], and not necessarily by objective assessments of engaging in risk behaviours. Given that HIV perceptions are salient for sharing PrEP information, future research should examine how WWID decide which network members may be at risk for HIV.

This study also found a significant interaction between being a transactional sex client or family member, and emotional closeness, on willingness to share PrEP information. However, the interaction was not significant for other relationship types. One possible explanation for why emotional closeness matters in these two relationships in particular is that ‘transactional sex client’ and ‘family’ may encompass the widest range of emotional closeness while the other types have less variability of emotional closeness. For example, Robertson et al. (2014) report that among women who engage in transactional sex in Tijuana, Mexico, transactional sex clients embody multiple, fluid types of relationships, ranging from a one-time nonregular client to long-term financial providers, and that as commercial relationships develop, social and emotional connections also increase [43]. In the present analysis, it is possible that sex clients with whom participants are not emotionally close are nonregular clients and discussing PrEP within the context of these relationships could be harmful [44, 45]. Sex clients with whom participants are emotionally close may be long-term financial providers with whom they feel safe to discuss PrEP. This

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same pattern of safety within relationships may also be relevant to family members. This finding is important because if only the main effect of relationship type was examined, the relational dynamics underlying PrEP information sharing would be missed, and it would likely be deduced that alters who are transactional sex clients and family members would most likely not receive PrEP information in a peer intervention.

Multiple dimensions of homophily were positively associated with willingness to share PrEP information within dyads. At the bivariate level, homophily of gender, injection drug use, and transactional sex were positively associated with willingness to share PrEP information. These finding are consistent with other studies that demonstrate the importance of homophily within relationships for sharing and receiving information [46]. Rogers (1995) explains that interpersonal similarity breeds both more communication and more effective communication [46]. Additionally receiving health information from a similar peer may result in a more positive attitude toward the information [46]. When adjusting for other factors, gender homophily is the only statistically significant homophily variable. The implications for peer-delivered PrEP interventions is that encouraging women to share information with other women may be effective at increasing PrEP awareness in this population.

The results of this study should be interpreted within the context of study limitations. The sample was not randomly selected and may not be generalizable to the broader population of WWID. In particular, it is possible that our study included more social and extroverted WWID who were willing to talk about PrEP because participants were selected if they were willing to speak with a network member about PrEP. It also needs to be highlighted that the interview guide asked participants to describe their willingness to share PrEP information in the context of an intervention where they would be trained and paid to share PrEP information. Thus, the willingness scenario is premised on participants getting paid and trained to share information. Lastly, we measured participants' "willingness" to share PrEP information with network members, which we acknowledge does not necessarily translate into future behaviour. However, we are primarily interested in knowing hypothetically with whom WWID are amenable to sharing PrEP information in the context of an intervention, and never expected participants to actually share information. Despite limitations, results suggest that HIV prevention efforts that tap into existing social networks among WWID to share PrEP information could be a viable way to increase PrEP awareness among vulnerable peers.

Conclusions

WWID interact with social network members who engage in a variety of behaviours that elevate their HIV risk, and WWID are willing to share PrEP information with the majority of people in their social network. Important dyadic characteristics such as gender homophily, relationship type and emotional closeness, are positively associated with willingness to share PrEP information. An important next step is to pilot and evaluate the effectiveness of a peer intervention where WWID share PrEP information with peers.

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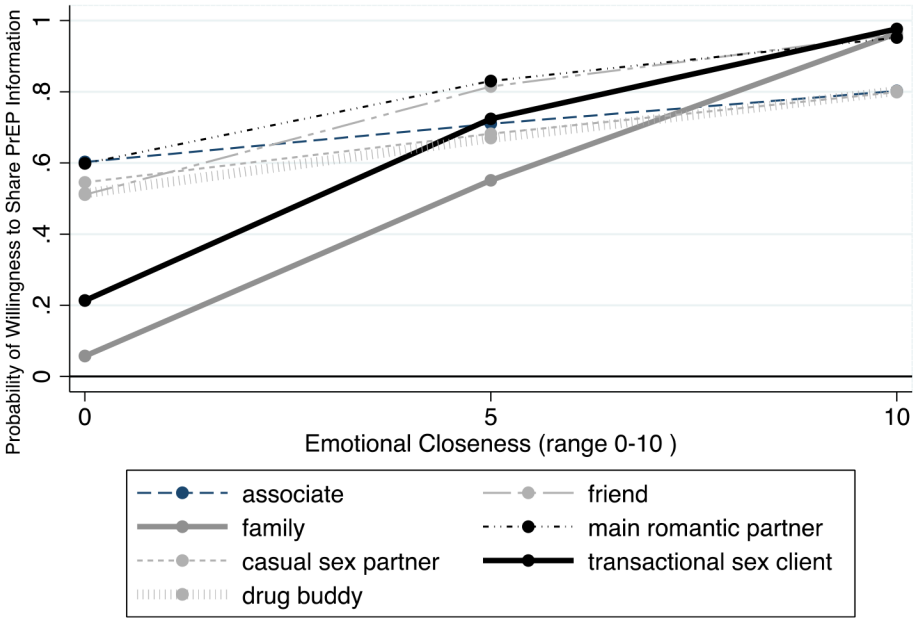

Fig. 1.
Interaction of emotional closeness and relationship type

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Table 1

Participant Characteristics (n = 40)

Mean Age ± SD	**40.1 ± 9.3**
Race (n = 37) *	
White	20 (54.1%)
Black	11 (29.7%)
Other	6 (16.2%)
Hispanic ethnicity	6 (15.0%)
Currently homeless	24 (60.0%)
Transactional sex	25 (92.5%)
Perceives herself as extremely/very likely to acquire HIV	19 (47.5%)
Accepted PrEP Rx	39 (97.5%)
Mean network size ± SD	9.3 ± 3.3

* Does not add to 40 due to missing data

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AIDS Behav. Author manuscript; available in PMC 2021 June 01.

Table 2

Predictors of willingness to Share PrEP information within Dyads (Tie Level, m = 375)

	Total sample	Willing to share PrEP information within Dyad			
		No 63 (16.8%)	Yes 312 (83.2%)	Unadjusted Odds Ratios (95%CI)	Adjusted Odds Ratios (95% CI)
Alter socio-demographics					
Mean Age ± SD	40.0 ± 12.8	43.8 ± 14.7	39.2 ± 12.2	0.9 ** (0.9–0.9)	–
Female	237 (63.2)	19 (30.2)	218 (69.9)	5.8 ** (2.5–13.6)	–
Race					
White	203 (54.3)	23 (36.5)	180 (57.9)	REF	–
Black	116 (31.0)	31 (49.2)	85 (27.3)	0.36 ** (0.2–0.8)	–
Other	55 (14.7)	9 (14.3)	46 (14.8)	0.65 (0.3–1.6)	–
Hispanic ethnicity	49 (13.1)	9 (14.2)	40 (12.9)	0.84 (0.4–1.9)	–
Social relations					
Relationship					
Acquaintance	87 (23.2)	13 (20.6)	74 (23.7)	REF	REF
Friend	133 (35.5)	13 (20.6)	120 (38.5)	1.03 (0.9–1.1)	0.6 (0.1–5.4)
Family member	64 (17.1)	9 (14.3)	55 (17.6)	1.02 (0.9–1.2)	0.1 ** (0.0–0.3)
Main romantic partner	29 (7.7)	5 (7.9)	24 (7.7)	1.0 (0.8–1.1)	1.0 (0.0–33.8)
Casual sex partner	14 (3.7)	6 (9.5)	8 (2.6)	0.2 ** (0.0–1.3)	0.7 (0.02–19.3)
Transactional sex client	23 (6.1)	11 (17.5)	12 (3.9)	0.1 ** (0.0–0.6)	0.1 (0.0–1.8)
Drug buddy	25 (6.7)	6 (9.5)	19 (6.1)	0.8 * (0.7–0.9)	0.6 (0.0–8.4)
Mean trust ± SD	5.6 ± 3.5	4.5 ± 3.12	5.8 ± 3.6	1.1 ** (1.0–1.3)	0.56 (0.1–5.4)
Mean emotional closeness ± SD	5.8 ± 3.31	4.4 ± 2.9	6.1 ± 3.3	1.2 ** (1.0–1.4)	–
Never/rarely verbally fight	271 (72.3)	44 (69.8)	227 (72.8)	1.0 (1.0–1.1)	–
Never/rarely physically fight	351 (93.8)	60 (95.2)	291 (93.6)	1.0 (0.9–1.2)	–
Homeless	126 (34.0)	9 (14.8)	117 (37.7)	3.3 ** (1.5–7.6)	2.8 * (1.0–7.5)
Injects drugs	231 (61.6)	28 (44.4)	203 (65.1)	2.3 ** (1.1–4.7)	–
Receives drugs/money/goods in exchange for sex	157 (41.8)	10 (15.9)	147 (47.1)	4.5 ** (1.6–12.5)	–
Perceived HIV status of alter					

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	Total sample	Willing to share PrEP information within Dyad			
		No 63 (16.8%)	Yes 312 (83.2%)	Unadjusted Odds Ratios (95%CI)	Adjusted Odds Ratios (95% CI)
HIV negative	223 (59.5)	47 (74.6)	176 (56.4)	REF	–
HIV positive	9 (2.4)	1 (1.6)	8 (2.5)	1.1 (0.8–1.4)	–
Unknown HIV status	143 (38.1)	15 (23.8)	128 (41.0)	1.1 * (1.0–1.2)	–
Perceived to be at high/medium risk for HIV	186 (50.8)	21 (33.9)	165 (54.3)	1.1 * (1.1–1.2)	4.2 * (1.6–11.1)
Currently taking PrEP	19 (5.1)	0 (0.0)	19 (6.1)	1.2 + (0.9–1.4)	–
Mean alters' interest in taking PrEP ± SD	3.3 ± 2.5	2.4 ± 1.9	3.5 ± 2.6	1.0 (1.0–1.0)	–
Homophily					
Gender homophily	237 (63.2)	19 (30.2)	218 (69.9)	5.8 ** (2.5–13.6)	3.7 * (1.2–11.6)
Race/ethnicity homophily	234 (64.7)	40 (64.5)	194 (64.7)	1.0 (0.9–1.1)	–
Injection drug use Homophily	231 (61.6)	28 (44.4)	203 (65.1)	2.3 * (1.1–4.7)	–
Transactional sex homophily	95 (25.8)	5 (7.9)	90 (29.5)	1.2 * (1.1–1.2)	–
Mean age difference ± SD	0.25 ± 1.9	−2.0 ± 1.9	0.7 ± 0.78	1.0 (1.0–1.0)	–
Do not live in same neighborhood	209 (55.7)	25 (39.7)	184 (59.0)	0.5 + (0.2–1.0)	–
Interactions within Dyads					
Shares drug injection equipment	18 (7.8)	3 (10.7)	15 (7.4)	0.95 (0.8–1.1)	–
Sexual relationship	85 (22.7)	27 (42.9)	58 (18.6)	0.3 ** (0.1–0.5)	–
Frequency of interaction					–
Daily/multiple times per week	271 (72.3)	36 (57.1)	235 (75.3)	REF	–
Monthly	76 (20.3)	18 (28.6)	58 (18.6)	0.5 + (0.3–1.1)	–
Yearly or less	28 (7.5)	9 (14.3)	19 (6.1)	0.3 + (0.1–1.0)	–
Mean relationship length in years ± SD	11.4 ± 0.73	14.6 ± 18.2	10.8 ± 13.2	0.5 + (0.3–1.1)	0.9 + (0.9–0.9)
Interaction terms					
Closeness x Friend	–	–	–	–	1.3 (0.9–1.9)
Closeness x Family	–	–	–	–	1.9 * (1.1–3.4)
Closeness x Main Partner	–	–	–	–	1.2 (0.8–1.9)
Closeness x Casual Partner	–	–	–	–	1.0 (0.6–1.7)
Closeness x Transactional sex client	–	–	–	–	1.7 * (1.1–2.8)

AIDS Behav. Author manuscript; available in PMC 2021 June 01.

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	Total sample	Willing to share PrEP information within Dyad			
		No 63 (16.8%)	Yes 312 (83.2%)	Unadjusted Odds Ratios (95%CI)	Adjusted Odds Ratios (95% CI)
Closeness x Drug Buddy	–	–	–	–	1.1 (0.6–1.9)
Closeness x Friend	–	–	–	–	1.3 (0.9–1.9)

$^{+}$ $p < 0.10$

* $p < 0.05$

** $p < 0.01$