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Intimate relationships and patterns of drug and sexual risk behaviors among people who inject drugs in Kazakhstan: A latent class analysis*

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Abstract

Background: Multiple drug and sexual risk behaviors among people who inject drugs (PWID) in intimate relationships increase the risk of HIV and HCV transmission. Using data on PWID in intimate partnerships in Almaty, Kazakhstan, this study performed latent class analysis (LCA) on drug and sexual risk behaviors and estimated associations between dyadic relationship factors and membership in latent classes.

Methods: LCA was performed on a sample of 510 PWID (181-females/FWID, 321-males/MWID) to identify levels of drug and sexual risk behaviors. Generalized structural equation modeling with multinomial regressions estimated associations between relationship factors (length risk reduction communication, risk reduction self-efficacy) and class membership after adjusting for substance use severity, overdose, depression, binge drinking, intimate partner violence,

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Phillip L. Marotta MSc. MPH, contributed to the writing of every section of the manuscript including all of the analysis and conceptualization of the core research questions. Assel Terlikbayeva MD, contributed to the writing of the introduction and discussion section. Louisa Gilbert PhD, contributed to the writing of all the sections particularly the introduction, methods and conclusion sections. Tim Hunt PhD contributed to the writing of the introduction methods and results section. Amar Mandavia M.A. contributed to the writing of the methods and results sections and carrying out the analysis of the study. Elwin Wu PhD contributed to the introduction and discussion sections. Nabila El-Bassel contributed writing to all sections of the manuscript as well as assistance in conceptualizing research questions and analysis. All authors contributed to and approved of the final version of the manuscript.

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No conflict declared.

structural factors, and sociodemographic characteristics. Models were sex-stratified to include FWID and PWID.

Results: A 3-class model best fit the data and consisted of low, medium, and high-risk classes. GSEM found that greater injection self-efficacy was associated with a lower likelihood of membership in the high-risk class for PWID and FWID. For MWID, greater length of the relationship was associated with a lower likelihood of membership in the medium-risk class. Greater relationship communication was associated with increased risk of membership in the high-risk latent class for MWID.

Conclusions: Future research must investigate if increasing risk reduction and safe sex self-efficacy could reduce drug and sexual risk behaviors and HIV transmission among PWID and their intimate partners. Interventions are needed that reduce power inequities within relationships as a method of increasing self-efficacy, particularly among women.

Keywords

People Who Inject Drugs; Injection Drug Use; Sexual Risks; Latent Class Analysis; Sexual Partnerships; Kazakhstan; Central Asia; Sex Differences

1. Introduction

Rates of HIV continue to grow among people who inject drugs (PWID) in Central Asia despite overall reductions worldwide in HIV incidence over the past decade (Degenhardt, 2016; Dehovitz et al., 2014; El-Bassel et al., 2013; Thorne et al., 2010). In Kazakhstan, HIV infection is expanding at a rate that is among the fastest in the world with an increase of 39% in new cases of HIV infections from 2010-2016 (UNAIDS, 2016). Kazakhstan has one of the highest rates of injection drug use in Eastern Europe and Central Asia (Vickerman et al., 2014) amounting to an estimated population of 120,500 in Kazakhstan (UNAIDS, 2016). Prevalence of HIV infection among PWID (8.5%) is 42.5 times greater than estimates of HIV prevalence in the general community (0.2%) (UNAIDS, 2016). High rates of injection drug risk behaviors have also led to widespread increases in HCV infection among PWID in Kazakhstan with estimates of HCV among PWID as high as 70.2% (Platt et al., 2017).

1.1 Drug and Alcohol Use in Kazakhstan

The risk environment conceptual framework organizes social determinants of sexual and drug risk behaviors into multiple levels that include: 1) individual, 2) intimate partnerships and other social relationships, and 3) structural (Rhodes, 2002; 2009). Individual factors include drug and alcohol use severity, which increases injection drug and sexual risk behaviors in Central Asia and other parts of the world (Azbel et al., 2015; El-Bassel et al., 2013a; 2013b; El-Bassel et al., 2014a; 2014b; 2014c; Marotta and El-Bassel, 2017). The rate of alcohol consumption in Kazakhstan is the highest in Central Asia with rates of alcohol use disorders of about 8% (WHO, 2015). Moreover, estimates of global lifetime prevalence of alcohol use disorders are as high as 60% amongst PWID (Azbel et al., 2015). In addition to substance use, mental health— and depression in particular— is closely associated with high-risk sexual and drug behaviors in Kazakhstan (Shaw et al., 2017a; Stein et al., 2003) and other countries (Armstrong et al., 2013; Brady et al., 2016; Ulibarri et al., 2015). Drug

use patterns, particularly mixing opioids with ephedrine and sedatives prior to injection, increases risk of HIV transmission and overdose amongst PWID in Central Asia because it lowers inhibitions and impairs judgment to practice safe sex and injection drug risk behaviors (UNODC, 2008; Tavitian-Exley et al., 2015; Stone, 2016; Coffin, 2008).

1.2 Intimate Partnerships and HIV Risks Among PWID

Global research on HIV risks among PWID who are in intimate partnerships identify relationship variables including greater closeness, trust, and intimacy as determinants of greater risk of sexual and injection drug risk behaviors with primary partners (Ibanez et al., 2016; Jiwatram-Negrón et al., 2014; Syvertsen et al., 2013; 2014; 2015; Ullibari et al., 2015; Seear et al., 2012). Risk reduction communication within intimate partnerships, including discussing the need to use condoms, getting tested for HIV/HCV and other STI, alternatives to vaginal or anal sex (i.e., oral sex, masturbation), how to prevent HIV and STI, and making sex more fun may greatly reduce HIV transmission among PWID in Kazakhstan (El-Bassel, 2013a; 2013b; 2014). In addition to risk reduction communication, research suggests that belief in one's capacity to insist on condom use, stop to look for condoms when sexually aroused, put condoms on intimate partners, and refuse to share syringes and other equipment with intimate partners protects against sexual and drug risk behaviors and HIV transmission among PWID and their intimate partners (El-Bassel et al., 2013; Gilbert et al., 2010; Jiwatran and El-Bassel, 2014). Gender inequalities perpetuate disparities in rates of sexual and drug risk behaviors as well as transmission of HIV (Blankenship et al., 2015; Rhodes, 2009; Marshall et al., 2004; Surrat et al., 2004). Experiencing intimate partner violence among FWID increases risky injection drug use and sexual behaviors, HIV transmission, and overdose (Gilbert et al., 2013; Marshall et al., 2008).

1.3 Structural Factors and HIV Risk Among PWID

Structural factors such as poverty and unemployment introduce barriers to adopting safe sex and injection drug practices among PWID and their intimate partners in Kazakhstan. The criminalization of drug use in Kazakhstan and throughout the world has led to heightened risk of HIV, HCV, and tuberculosis among PWID by virtue of overcrowding, poor sanitary conditions, lack of access to sterile syringes, and lack of access to or lapses in drug treatment (Altice et al., 2016; Azbel et al., 2015; 2016; Dolan et al., 2016; DeBeck et al., 2017; Jurgens, et al., 2011; Rubenstein et al., 2016).

1.4 The Need to Identify Profiles of Sexual and Drug Risks Among PWID in Kazakhstan

Research to identify typologies of drug and sexual HIV risk behaviors amongst PWID and their intimate partners is yet to occur in Kazakhstan or anywhere else in Central Asia despite a growth of studies identifying overlapping sexual and injection drug vulnerabilities to HIV infection experienced by PWID (El-Bassel, 2013; 2014; Syvertson, 2013). Studies that examine individual HIV risks do not adequately capture the intertwined nature of drug use and sexual risks within microsocial contexts of intimate partnerships amongst PWID leading to HIV prevention interventions that focus on only a single transmission pathway rather than multiple intersecting drivers of HIV. Third, few studies examine gender differences in subtypes of high-risk drug and sexual behaviors among PWID, which results in samples that rely upon findings from samples of predominantly MWID rather than FWID.

To address these gaps, we performed an exploratory latent class analysis (LCA) on drug and sexual HIV risk behaviors among PWID who are in intimate partnerships in Kazakhstan. After identifying if more than one underlying class fit the data, this study examined associations between relationship variables (relationship length, risk reduction self-efficacy, communication with partners) and membership in latent classes after adjusting for age, substance use (severity, overdose, problematic drinking), depression, intimate partner violence, and need for HIV counseling. All models examined gender differences in subtypes of high-risk drug and sexual behaviors and predictors of latent classes.

2. Methods

2.1 Study Population and Data Collection Procedures

This paper used a subset of data from *Project Renaissance*, a randomized controlled trial that evaluated the efficacy of a couples-focused behavioral HIV prevention intervention in which one or both partners reported recent injection drug use which was conducted between 2009-2012 (El-Bassel, 2014). Analyses presented herein utilized data from the baseline assessment. The Columbia University Institutional Review Board and the Kazakhstan School of Public Health Institutional Review Board approved the study protocol prior to conducting the research.

2.2 Eligibility Criteria and Recruitment

Syringe exchange programs, HIV treatment and prevention clinics, and outdoor locations provided settings to recruit eligible participants through word-of-mouth by way of injecting social network members and targeted outreach. PWID and their intimate partners were recruited if they 1) were older than 18 years old, 2) defined their heterosexual partners as a spouse, lover, boyfriend/girlfriend, or parent of his or her child, 3) reported the length of their relationship as greater than 6-months, 4) expressed intentions to remain in their intimate relationships for at least a year, and in the last 90 days at least one partner reported 5) engaging in unprotected sex (vaginal or anal) with the other partner. The sample for this study was the subset of 510 participants who reported engaging in injection drug use in the past 90 days.

2.2.1 Assessment.—Research assistants conducted pre and post-test counseling on HIV, HCV, and other STIs in a gender-specific room. All participants received post-test counseling that included notification of HIV, HCV, and STI test results within two weeks. Participants received compensation for completing the baseline assessment and biological testing of comparable value to about \$10.

2.3 Measures

2.3.1 Biological Testing.—Biological assays tested for the presence of HIV, HCV, and STI (syphilis, gonorrhea, and chlamydia) using a dried blood spot technique (DBS) and were analyzed at the Republican AIDS Center (RAC) in Almaty, Kazakhstan. Cases of HIV and HCV were identified using a serial two-test strategy based on standards from the World Health Organization that used the Enzyme-Linked Immunosorbent Assay (ELISA) followed by the Abbott Murex Biotech test with a reported sensitivity of >99.99% and specificity of

99.99%. The measure for HCV infection reflects having ever been infected with HCV rather than active HCV infection.

2.3.2 Classification Indicators for Latent Class Analysis.—Classification indicators included 12 dichotomous items on unsafe injection behaviors, other drug use, and sexual risk in the past 90 days.

Unsafe injection behaviors encompassed: 1) receptive syringe or equipment sharing with others, 2) receptive syringe or equipment sharing with study partners, 3) syringe mediated sharing (drawing injection fluid from another syringe into the syringe for injection), 4) injecting drugs after someone squirted drugs into it from his or her syringe, 5) using a syringe prepackaged with heroin, 6) injecting drugs prepared using a common container, and 7) more than one injecting partner. *Other drug use* included: 8) drinking alcohol immediately prior to use of heroin and 9) mixing drugs with heroin when injecting. *Sexual risk* included 10) the classification indicator of never/ always engaging in condomless sex with primary intimate partners, given that the inclusion criteria included engaging in condomless sex in the past 90 days, 11) sex under the influence of drugs or alcohol with study partners, and 12) condomless sex with outside partners in the past 90 days.

2.3.3 Potential Predictors of Latent Class Membership.—*Relationship length* was measured by asking participants how long they were in intimate sexual relationships with study partners (years). *Risk reduction communication* included how many times PWID discussed 1) the need to use condoms, 2) getting tested for HIV/HCV or other STIs, 3) oral sex as an alternative to vaginal or anal sex, 4) masturbation as an alternative to vaginal or anal sex, 5) how to prevent HIV, 6) how to prevent STI, 7) making safe sex more fun, 8) discussing the need to stop sharing syringes, and 9) discussing the need to use new syringes with each new injection in the past 90 days (Gomez, 1996). Items measuring *male condom use efficacy and risk reduction self-efficacy* consisted of self-reported confidence with 1) discussing condom use with intimate partners, 2) insisting on condom use even if their partner does not want to use one, 3) stopping to look for condoms when sexually aroused, 4) insisting on condom use every time when the participant is under the influence of drugs or alcohol, 5) insisting on condom use every time even when the study partner is under the influence of drugs or alcohol, 6) putting a condom on study partner without spoiling the mood, 7) insisting on condom use even if partner uses other forms of contraception, and 8) refusing to share syringes even if their partner wants to use same needle (0 no, 1 probably no, 2 maybe, 3 probably yes, 4 definitely yes) (Deren and Kang, 2003; Kang and Deren, 2001; Windgood and DiClemente, 1998). All question items were dichotomized (1=yes) and summed with greater scores indicating more communication regarding risks between partners.

Drug Use Severity was measured with a scale summing the 9 question items of the Texas Christian University drug screen measured drug use severity (Institute of Behavioral Research, 2008; Knight et al., 2002). *Opioid Overdose*, a dichotomous variable, measured experiencing at least one opioid overdose in the past 6-months. *Problem drinking* was indicated if participants reported drinking 5 or more alcoholic beverages in a 6-hour period in the past 90 days. *Depression*: The Brief Symptom Inventory (BSI) is a 6-item scale

measuring depression consisting of 1) thoughts of suicide, 2) feeling lonely even with other people, 3) feeling sad, 4) no interest in things, 5) hopelessness, and 6) worthlessness (alpha .85) (4 - extremely, 3 - quite a bit, 2 - moderately, 1 - a little bit, 0 - not at all) (Derogatis and Melisaratos, 1983). Intimate partner violence measured any physical, emotional, psychological, or sexual abuse from an intimate partner ever or in the past 6-months (1=Yes). *Structural factor: Unmet need for HIV and STD counseling* was measured by asking participants if in the past 6-months they needed HIV counseling or education. *Poverty*: participants whose self-reported income was less than 15,000 Tenge were classified as impoverished (El-Bassel, 2014). *Criminal justice involvement* included lifetime conviction for a drug crime (1=Yes). Appendix 1¹ shows Spearman rank correlation coefficients between classification indicators for the whole sample.

2.4 Data Analysis

Exploratory LCA involves fitting incrementally increasing models up to 5 and selecting the appropriate number of classes using the Bayesian Information Criterion (BIC), the sample size adjusted BIC, AIC, Lo-Mendel Rubin (LMR), the Bootstrapped Likelihood Ratio Test (BLRT), and Entropy (McCutcheon, 1987; Formann, 1984; Hagenaars and McCutcheon, 2002; Formann, 1984). This method is in contrast with LCA involving a priori hypothesis testing in which a predetermined number of classes are hypothesized and fit to the data in a single model. Exploratory LCA evaluated model fit statistics for the sample size adjusted SSBIC, BIC, and AIC and involved comparing test statistics from nested models and selection of the information criterion with the lowest number (Nylund et al., 2007; Jung and Wickrama, 2008). Model performance indicators for the bLRT tests the hypothesis that the model with one additional class is a significantly better fit than the model with one less class (Nylund et al., 2007; Muthén and Muthén, 2015). Latent class analyses were performed in Mplus, and posterior probabilities were imported into STATA for descriptive and multivariable regression analyses (Muthén and Muthén, 2015; Geiser, 2012; StataCorp, 2013). We performed gender-specific goodness of fit analyses to assess the data for differences in class membership between MWID and FWID.

In the overall models, a generalized structural equation model (GSEM) with a couple-level random coefficient accounted for the nominal outcome variable and dyadic, nested structure of the data (Gu et al., 2013; Rabe-Hesketh et al., 2002; Rabe-Hesketh and Skrondal, 2004). Given the nested structure of the data, a generalized structural equation model accounted for the shared variance of participants within couples. The structure of the data is individuals within partnerships (with all individuals nested within the same number of partnerships (2)). Dyadic data that is modeled at the individual level must be treated as nested data, and the shared variance between the 2nd order variable (couples) must be controlled to generate statistical inference at the individual-level. Paths from hypothesized covariates to latent classes estimated the effects of individual-level relationship variables (self-efficacy and communication) on sexual and drug risk behaviors with a random coefficient with the shared variance between couples to adjust for the dyadic structure of the data (StataCorp, 2013) (Figure 1). Two GSEM multinomial models were fit 1) with class 1 and 2) class 2 as reference categories. The unit of analysis for this study is at the individual-level rather than within couple measures. Parameter coefficients in the multinomial regression models were

exponentiated from multinomial logits to relative risk ratios (RRR) and are presented with standard errors and p-values. Sex-stratified models examined differences in class membership for FWID and MWID with multinomial regression techniques using maximum likelihood (Long and Freese, 2006; Freese and Long, 2000; Hamilton and Seyfrit, 1993).

Sensitivity analysis on data from the parent study found participants who did not engage in injection drug use in the past 90 days (n=218) were similar to PWID on all of the relationship variables (length, self-efficacy, and communication) as well as binge drinking, needing HIV/STI counseling, IPV, age, and poverty (See appendix 2)². The proportion of participants infected with HIV, HCV, and HIV/HCV co-infection, as well as overdose and prior drug crime conviction, were higher among PWID. Scores on the depression and drug use severity scales were higher for PWID compared to non-PWID.

3. Results

3.1 Goodness of Fit Statistics

Goodness of fit values is presented in Table 1 for the AIC, BIC, BICa, and bLRT information criteria as well as the LMR test statistic. The values for the BIC increased in class 4 over class 3 supporting the selection of the three-class model. The improvement provided by the four- compared to the three-class models was not statistically significant ($p < .05$) using the bLRT and LMR, lending further support for the selection of the 3-class model. Goodness of fit statistics in the models stratified by sex closely mirrored findings in the overall model, suggesting a similar number of latent classes underlying sexual and drug risk behaviors for FWID and MWID.

3.2 Latent Class Probability and Class Description

The first risk class accounted for nearly a quarter (.23, n=119) of the sample of PWID (Table 2). More than a third (.38, n=193) were in the second risk class, and the remaining participants (.39, n=198) were in the third risk class. In the first risk class, the probability of endorsing all of the injection drug risk variables was low with a high probability of unprotected sex with study partners. We named this class “low-risk.” Members of the second class had a high probability of syringe-mediated sharing and sharing using a common container alongside a high probability of unprotected sex with intimate partners. We named this class “medium-risk.” In support of the hypothesis of the number of classes, the third risk class exhibited a high probability on all classification items with the exception of unprotected sex with non-intimate partners. We labeled class 3 “high-risk.”

3.3 Descriptive Analyses of Independent Variables and Latent Classes of Sexual and Drug Risks

Table 3 presents means (M) with standard errors (SE) and proportions for the predictors of class membership as well as bivariate tests of significance of differences between FWID and MWID.

On average, PWID in the highest risk class was in relationships with their intimate partners for shorter periods of time ($M=4.57$ $SE=.42$) compared to the low-risk class ($M=6.36$, $SE=$.

62, $p < .01$) (Table 4). Relationship risk reduction self-efficacy was significantly lower in the high-risk (19.28, SE=8.91) compared to the low-risk class (20.49, SE=.89, $p < .05$). Risk reduction communication was higher in the high ($M=2.65$, SE=.18) than the medium ($M=2.38$, SE=.17, $p < .05$) and low-risk classes ($M=1.48$, SE=.18, $p < .001$).

3.4 Multivariate Regressions

FWID were more likely than MWID to be in the medium-risk class (RRR=1.71, SE=.48, $p < .05$) than low-risk class (Table 4). Greater age was associated with a lower likelihood of membership in the high- compared to the medium- (RRR=.95 SE=.02, $p < .05$) and low-risk class (RRR=.96 SE=.02, $p < .05$). For MWID, individuals in the high-risk (RRR=.94, SE=.02, $p < .01$) class were younger compared to the medium-risk class.

3.4.1 Relationship Context.—Overall greater relationship risk reduction self-efficacy was associated with lower likelihood of class membership in the high- (RRR=.96, SE=.02, $p < .01$) and medium-risk classes (RRR=.95, SE=.02, $p < .05$) compared to the low-risk class. Greater communication about risk reduction was associated with a greater likelihood of membership in the high- (RRR=1.32, SE=.10, $p < .001$) and medium-risk classes (RRR=1.21, SE=.08). For FWID, higher self-efficacy for negotiating safe sex and injection behaviors was associated with a lower likelihood of membership in the high- (RRR=.91, SE=.03, $p < .001$) and medium-risk classes (RRR=.92, SE=.02, $p < .001$). For MWID, greater relationship length was associated with lower likelihood of membership in the medium- (RRR=.94, SE=.02, $p < .01$) compared to low-risk class. MWID who engaged in communication about risk reduction with partners were more likely to be in the high- compared to low-risk class (RRR=1.26, SE=.10, $p < .001$).

3.4.2 Substance Use.—Severity of drug use was associated with a greater probability of membership in the high (RRR=1.31, SE=.11 $p < .001$) and medium-risk classes (RRR=1.16, SE=.07, $p < .05$) compared to the low-risk class. Problem drinking was associated with a greater probability of membership in the high (RRR=3.13 SE=1.08 $p < .05$) compared to the low HIV risk behavior class. Greater drug use severity was associated with membership in the high-risk class for FWID (RRR=1.48, SE=.20, $p < .01$) and MWID (RRR=1.32, SE=.14, $p < .05$). FWID with severe drug use were more likely to be in the medium- (RRR=1.27, SE=.14, $p < .05$) than low-risk class. Problem drinking was associated with increased risk of membership in the high- (RRR=5.80, SE=3.00, $p < .01$) and medium-risk classes for FWID (RRR=3.02, SE=1.26, $p < .01$).

3.4.3 Mental Health.—Self-reported symptoms of depression were significantly associated with membership in the high- compared to low-risk class (RRR=1.08 SE=1.04, $p = .05$).

3.4.4 Structural Factors.—Need for HIV/STD counseling was associated with increased likelihood of membership in medium- (RRR=1.91 SE=.47, $p < .01$) and high-risk classes of HIV risk behaviors (RRR=2.85, SE=.92, $p < .01$). When stratified by sex, the self-reported need for HIV and STI counseling was associated with membership in the high- (RRR=3.06, SE=1.00, $p < .001$) and medium- (RRR=2.40, SE=.90, $p < .05$) compared to low-

risk categories for MWID. For FWID, poverty (RRR=2.40, SE =.90, $p<.05$) was associated with increased risk of membership in the high-risk class for the high compared to medium-risk class.

4. Discussion

This paper addresses a significant gap in the literature by applying LCA to identify clusters of high-risk sexual and drug-related behaviors among PWID in Kazakhstan. Overall, nearly a quarter of the sample were in the low-risk class characterized by unprotected sex and sex under the influence of drugs and alcohol but low probability of injection drug risk behaviors, illicit drug use, drug mixing, and risky sexual behaviors. A medium-risk class (class 2) consisted of sexual risk behaviors with intimate partners, front or backloading, sharing a common container, and drinking alcohol immediately before using heroin. The high-risk class consisted of a high probability of receptive syringe sharing with study partners and others, front or backloading, squirting injection drug fluid, sharing a common container, multiple injection partners, drinking alcohol immediately prior to using heroin, sex under the influence of drugs and alcohol, and unprotected sexual behaviors with primary partners.

Members of the medium-risk class were more likely to be female compared to those of the low-risk class. Additionally, participants who were in the high-risk class were younger compared to the low-risk class. Depressive symptoms were related to greater likelihood of class membership in the high-risk class of drug and sexual behaviors. Prior literature on single risk factors supports these findings in Kazakhstan (Shaw, 2017) and other parts of the world (Armstrong et al., 2013; Ulibarri et al., 2015). Members of the high and medium-risk classes were more likely to report severe substance use problems compared to the low-risk class for the overall sample.

Greater safe sex and injection drug self-efficacy was a protective factor against membership in the high-risk sexual and drug behavior class for FWID. Greater length of time in intimate partnerships was associated with a lower likelihood of membership in the medium-risk class compared to partnerships for less time for MWID. Greater scores on relationship risk reduction self-efficacy predicted lower risk of membership in the high-risk (class 3) compared to the low-risk (class 1) classes of drug and sexual risk behaviors. Surprisingly, greater communication with partners about risk reduction was associated with a greater risk of membership in the highest risk class. PWID who are engaged in more risk behaviors may have more opportunities to discuss them with their partners compared to other classes, which by definition would afford greater opportunities for discussing risk reduction.

4.1 Implications for HIV Prevention and Substance Use Treatment with PWID Who Are in Intimate Sex Partnerships

Prevention programs for PWID must address multiple domains of risk behaviors simultaneously within the contexts of intimate partnerships. It is critical that evidence-based HIV prevention programs integrate effective drug and sexual risk reduction interventions such as multi-level HIV/STI prevention strategies, HIV/STI testing and counseling, and PrEP alongside the provision of condoms, sterile syringes, and injection equipment. Targeted HIV prevention programs must incorporate interventions that combine evidence-

based principles to address the comprehensive service needs presented by PWID. Risk reduction interventions must encourage PWID and their intimate partners to engage in safer sexual and injection drug risk behaviors within a single package of evidence-based interventions. Gender inequities in relationships may erode self-efficacy of PWID to insist on safe sexual and drug practices within micro-social contexts of intimate partnerships in Kazakhstan. Future research is necessary among couples who use drugs to further explore relationships between gender inequities and relationship factors among PWID and their intimate partners in Kazakhstan.

4.2 Limitations

Several limitations warrant elucidation. First, the data are cross-sectional and thus precludes temporal ordering and causal inference of findings from regressions between predictor variables and HIV risk classes. Second, self-report bias may lead to underestimation of engagement in drug and sexual risk behaviors. Third, although the study is with participants in a couples-focused HIV prevention intervention, the data is at the individual and not the dyadic level. Not all participants engaged in injection drug use in the past 90 days, which includes several of the classification indicators restricting the data to a subset of participants in the Project Renaissance sample. Given the individual-level data, it is not possible to generalize to the couple-level. Statistical inference at the couple-level would lead to an ecological fallacy about the behaviors of dyads of PWID. Future inquiry must extend beyond individual-level research to explore dyadic data analyses accounting for both partners' behaviors. Research studies are needed that elucidate the influence of partners' relationship self-efficacy and communication, drug use severity, and other factors on latent classes of injection drug and sexual risk behaviors among PWID. Future research is needed that examines within-partnership/couple measures such as values summed across partner values for injection drug risk behaviors with intimate partners. Fourth, a statistical limitation of the LCA technique used in this study assumes the 12 drug and sexual HIV transmission risk classification indicators are locally independent when conditioned on the latent construct of risk. Finally, sensitivity analysis suggested that restricting the sample to only PWID resulted in some selection bias in which PWID with more severe substance use profiles and HIV needs were included in the analysis.

5. Conclusion

Limitations notwithstanding, each of the identified subtypes of drug and sexual risk behaviors informs different strategies and avenues for HIV prevention with PWID in Kazakhstan. The low-risk category class may benefit from interventions that focus primarily on sexual risk behaviors with less focus on drug-related risks. The medium-risk class might benefit from the provision of sterile injection equipment and education surrounding the risks presented by sharing equipment. The highest risk group requires HIV prevention programs that target the overlap between several drugs and sexual risk behaviors. Future research must focus on these relationships longitudinally to identify how these subtypes of risks change over time. Findings from this paper emphasize the heterogeneity of HIV risk behaviors among PWID in Kazakhstan. Increasing coverage and uptake of HIV prevention programs

must acknowledge the intertwined nature of drug use and sexual risks in intimate partnerships driving HIV/HCV infection and overdose in Kazakhstan.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- Latent class analysis on sexual and drug HIV risks among PWID in Kazakhstan.
- Identified 3 underlying latent classes of low, medium, and high HIV risk behavior.
- Similar latent class structure between men, women and overall.
- Shorter relationship length associated with medium-risk class membership for men.
- Low risk reduction self-efficacy associated with high/medium class for women.

Figure 1.

Full two-level generalized structural equation multinomial regression model with shared couple-level random effects used in overall models of predictors of class membership for the whole sample.

Notes: TCU=Texas Christian University Scale; Depression=Brief Symptom Inventory; Risk classes are factor variables of membership in classes 3 and 2 versus class 1.

Table 1.

Goodness of fit statistics.

	PWID				FWID				MWID			
	2-class	3-class	4-class	5-class	2-class	3-class	4-class	5-class	2-class	3-class	4-class	5-class
AIC	6432.20	6291.63	6275.91	6266.38	2320.40	2293.34	2294.35	2296.07	3830.53	3728.67	3716.73	3720.47
BIC	6538.06	6452.54	6491.87	6537.38	2401.44	2416.53	2448.48	2493.54	3924.82	3871.98	3909.07	3961.84
BICa	6458.70	6331.91	6329.99	6334.24	2322.25	2296.17	2290.94	2290.82	3845.52	3751.45	3755.31	3758.84
Ent	.85	.83	.83	.79	0.84	.89	.89	.90	0.84	0.83	0.84	0.83
bLRT	p<.001	p<.001	p=.07	0.41	p<.001	0.025	0.26	0.17	p<.001	p<.001	0.40	0.07
LMR	p<.001	p<.001	p=.06	0.42	p<.001	0.03	0.26	0.17	p<.001	p<.001	0.41	0.07

Table 2.

Probability of class membership for HIV injection and sexual risk classification indicators.

	Overall			FWID			MWID		
	Low-risk	Medium Risk	High Risk	Low-risk	Medium Risk	High Risk	Low-risk	Medium Risk	High Risk
Class counts and proportions [/]	119(.23)	193(.38)	198(.39)	34(.18)	73(.39)	82(.43)	91(.28)	130(.40)	100(.31)
Classification indicators									
1 RSES others	.08(.03)	.28(.11)	.99(.05)	.15(.07)	.20(.08)	1(0)	.06(.03)	.38(.18)	1(0)
2 RSES study partners	.07(.03)	.28(.07)	.64(.05)	.07(.05)	.38(.06)	.72(.05)	.06(.03)	.26(.75)	.59(.06)
3 Front or back loading	.03(.04)	.86(.06)	.99(.008)	0(0)	.79(.06)	.99(.01)	.05(.04)	.92(.06)	1(0)
4 Squirt inject fluid	.06(.02)	.09(.05)	.75(.09)	.12(.06)	.10(.04)	.77(.07)	.04(.02)	.11(.05)	.79(.18)
5 Prepack injection solution	.07(.03)	.20(.05)	.51(.05)	.12(.88)	.18(.05)	.48(.07)	.06(.03)	.23(.04)	.55(.11)
6 Sharing common container	.02(.06)	.89(.04)	.99(.01)	0(0)	.85(.05)	1(0)	.05(.03)	.93(.04)	.98(.02)
7 Multiple injection partners	.03(.03)	.16(.07)	.66(.06)	.09(.05)	.16(.05)	.66(.07)	.02(.02)	.18(.10)	.69(.08)
8 Drink before using heroin	.39(.05)	.58(.04)	.76(.04)	.28(.09)	.51(.49)	.70(.06)	.23(.05)	.62(.06)	.82(.11)
9 Mixed drugs with heroin	.23(.04)	.41(.05)	.54(.04)	.26(.09)	.40(.06)	.54(.06)	.44(.06)	.42(.05)	.55(.08)
10 No condom use with partner	.68(.05)	.65(.05)	.70(.05)	.83(.07)	.79(.05)	.95(.03)	.87(.04)	.93(.03)	.87(.04)
11 Sex drugs/alcohol	.76(.04)	.90(.03)	.93(.02)	.72(.08)	.87(.04)	.94(.03)	.77(.05)	.94(.03)	.91(.04)
12 Unprotected sex with others	.08(.04)	.08(.03)	.22(.04)	.06(.04)	0(0)	.15(.04)	.10(.04)	.12(.04)	.27(.08)

[/] Past 90 days

Table 3.

Descriptive statistics of relationship factors, HIV/HCV infection, substance use, mental health trauma, structural and sociodemographic characteristics for FWID and MWID and overall (PWID).

	PWID	MWID	FWID	p-value
Relationship Factors				
Relationship Length Mean(SD)	5.19(.27)	5.47(.46)	5.02(.33)	0.215
Communication Mean(SD)	2.27(.18)	2.02(.13)	2.70(.18)	<.001
Self-efficacy Mean(SD)	20.15(.62)	20.50(.52)	20.15(.62)	0.334
HIV/HCV cases				
HIV %(n)	29.02(148)	28.97(.93)	29.02(148)	0.97
HCV %(n)	91.18(465)	90.97(292)	91.53(173)	0.827
HCV/HIV %(n)	25.88(132)	26.48(85)	24.87(47)	0.688
Substance use				
TCU-II Scale Mean(SD)	7.18(.09)	7.14(.11)	7.25(.15)	0.277
Overdose %(n)	22.16(113)	21.50(69)	23.28(44)	.639
Problem drinking %(n)	68.43(349)	73.52(236)	59.79(113)	<.001
Mental health/Trauma				
Depression Mean(SD)	7.05(.25)	6.08(.30)	8.70(.42)	<.001
IPV %(n)	18.04(92)	19.31(62)	15.87(30)	0.329
Unmet service needs				
HIV/STD %(n)	55.29(282)	52.65(169)	59.79(113)	0.117
Sociodemographic				
Age Mean(SD)	36.42(.51)	36.80(.42)	35.79(.51)	0.07
Structural conditions				
Poverty %(n)	40.59(207)	35.83(115)	48.68(92)	0.004
Drug crime %(n)	73.92(377)	75.39(242)	71.43(135)	0.325

Table 4.

Differences between latent classes and sociodemographic, drug use, service utilization and structural factors for PWID (n=510).

	Class 1 (119)	Class 2 (193)		Class 3 (198)		
			p-value 2 vs 1	%(n)	p-value 3 vs 1	3 vs 2
Relationship factors M(SE)						
Length	6.36(.62)	5.10(.41)	0.096	4.57(.42)	0.014	0.356
Self-Efficacy	20.49(.89)	21.42(.61)	0.425	19.28(.63)	0.249	0.019
Communication	1.48(.18)	2.38(.17)	0.041	2.65(.18)	0.002	0.145
HIV/HCV %(n)						
HIV	31.93(38)	30.57(59)	.784	25.76(51)	.267	.784
HCV	87.39(104)	90.67(175)	.348	93.94(186)	.055	.288
HCV/HIV	26.05(31)	26.42(51)	.948	25.25(50)	.886	.831
Substance use						
TCU-II Scale M(SE)	6.38(.20)	7.17(.13)	.004	7.68(.14)	<.001	.017
Problem drinking %(n)	57.98(69)	65.80(127)	.144	77.27(153)	<.001	.015
Overdose						
Lifetime	63.03(75)	68.91(133)	.218	78.79(156)	.003	.045
Recent	13.45(16)	16.58(32)	.382	32.83(65)	<.001	.001
Depression M(SD)	5.50(.25)	6.62(.38)	.060	8.41(.42)	<.001	.004
Intimate partner Violence %(n)						
Lifetime	40.34(48)	51.30(99)	.058	59.60(118)	.002	.172
Recent	9.24(11)	16.06(31)	.082	25.25(50)	.001	.049
Unmet service needs %(n)						
HIV/STD	40.34(48)	55.96(108)	.009	63.64(126)	<.001	.167
Structural conditions %(n)						
Poverty	41.18(49)	34.72(67)	.260	45.96(91)	.504	.037
Drug crime	68.07(81)	72.54(140)	.416	78.79(156)	.047	.140
Sociodemographic						
Female %(n)	27.73(33)	38.86(75)	.044	40.91(81)	.019	.858
Age M(SE)	37.88(.73)	37.03(.54)	.272	34.95(.46)	.001	.012

Tests of differences performed using unadjusted multinomial regression with generalized structural equation modeling with couple level random effects comparing membership in latent classes

Table 5.
Adjusted Relative Risk Ratios from multinomial regression models predicting latent class membership.

	PWID ^a			FWID ^b			MWID ^b		
	2 vs. 1	3 vs. 1	3 vs. 2	2 vs. 1	3 vs. 1	3 vs. 2	2 vs. 1	3 vs. 1	3 vs. 2
	RRR(SD)	RRR(SD)	RRR(SD)	RRR(SD)	RRR(SD)	RRR(SD)	RRR(SD)	RRR(SD)	RRR(SD)
Relationship factors									
Length	.97(.02)	.99(.03)	1.01(.03)	1.02(.03)	1.02(.03)	1.01(.03)	.94(.02) [*]	.98(.03)	1.03(.03)
Self-Efficacy	.99(.01)	.96(.02) ^{**}	.96(.03) ^{**}	.99(.03)	.91(.03) ^{***}	.92(.02) ^{***}	.99(.02)	.98(.02)	.98(.02)
Communication	1.21(.08) ^{**}	1.32(.10) ^{***}	1.09(.06)	1.19(.14)	1.27(.18) ⁺	1.06(.08)	1.14(.09) ⁺	1.26(.10) ^{***}	1.10(.07)
Sociodemographic									
Female sex	1.71(.48) [*]	1.40(.45)	.83(.23)						
Age	1.01(.02)	.96(.02) [*]	.95(.02) [*]	.98(.03)	.94(.04) ⁺	.96(.03)	1.03(.02)	.97(.02)	.94(.02) ^{**}
Substance use									
TCU-Score	1.16(.07) [*]	1.31(.11) ^{***}	1.13(.09)	1.27(.14) [*]	1.48(.20) ^{**}	1.18(.13)	1.14(.08) ⁺	1.32(.14) [*]	1.17(.11)
Overdose	1.19(.32)	1.59(.52)	1.35(.41)	.77(.38)	1.53(.92)	1.97(.98)	1.49(.49)	1.46(.51)	.98(.32)
Problem Drinking	1.47(.50)1.62(.45) ⁺	3.13(1.08) ^{**}	1.92(.62) [*]	1.47(.50)1.91(.89)	5.80(3.00) ^{**}	3.02(1.26) ^{**}	1.47(.50)	1.92(.75) ⁺	1.31(.43)
Mental health/IPV									
Depression	1.01(.03)	1.08(.04) [*]	1.06(.03)	1.01(.05)	1.07(.05)	1.06(.04) ⁺	1.01(.03)	1.03(.03)	1.02(.03)
IPV	1.10(.29)	1.18(.36)	1.08(.28)	1.05(.48)	.65(.36)	.65(.28)	1.17(.36)	1.26(.42)	1.07(.30)
Unmet service needs									
HIV/STD	1.91(.47) ^{**}	2.85(.92) ^{**}	1.50(.42)	1.60(.73)	2.06(1.03)	1.29(.51)	2.50(.74) ^{**}	3.06(1.00) ^{***}	1.22(.35)
Structural conditions									
Poverty	.65(.16)	1.02(.30)	1.55(.39) ⁺	.90(.42)	2.18(1.12)	2.40(.90) [*]	.58(.18) ⁺	.94(.33)	1.64(.49)
Drug conviction	1.05(.33)	1.64(.61)	1.54(.51)	1.84(.86)	2.16(1.24)	1.17(.58)	.87(.31)	1.13(.46)	1.30(.47)

<p<.001

**
p<.01

*
p<.05

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Modeling using generalized structural equation modeling with couple level random effects (n=510)
Modeling using polytomous regression with maximum likelihood
Modeling using generalized structural equation modeling with couple level random effects (n=510)
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