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Relationship-level analysis of drug users' anticipated changes in risk behavior following HIV vaccination

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Abstract

Formative research into the behavioral factors surrounding HIV vaccine uptake is becoming increasingly important as progress is made in HIV vaccine development. Given that the first vaccines on the market are likely to be partially effective, risk compensation (i.e. increased risk behavior following vaccination) may present a concern. This study characterized the relationships in which HIV vaccine-related risk compensation is most likely to occur using dyadic data collected from people who use drugs, a high-risk group markedly underrepresented in extant literature. Data were collected from 433 drug users enrolled in a longitudinal study in the US. Respondents were asked to provide the first name and last initial of individuals with whom they had injected drugs and/or had sex during the past 6 months. For each partner, respondents reported their likelihood of increasing risk behavior if they and/or their partner received an HIV vaccine. Using generalized linear mixed models, relationship-level correlates to risk compensation were examined. In bivariate analysis, risk compensation was more likely to occur between partners who have known each other for a shorter time (OR=0.95, 95% CI: 0.90-0.99, $p=0.028$) and between those who inject drugs *and* have sex together (OR=2.52, CI: 1.05-6.04, $p=0.039$). In relationships involving risk compensation, 37% involved partners who had known each other for a year or less compared to only 13% of relationships not involving risk compensation. Adjusting for other variables, duration (OR: 0.95, CI: 0.90-1.00 $p=0.033$) was associated with risk compensation intent. These analyses suggests that risk compensation may be more likely to occur in less established relationships and between partners engaging in more than one type of risk behavior. These data provide further support for the need to expand measures of risk compensation in HIV vaccine preparedness studies to assess not only *if* people will change their behavior, but also *with whom*.

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Keywords

HIV vaccine; risk compensation; social network; injection drug use; condom use

Introduction

As advancements are made in HIV vaccine development, the likelihood of reversing the HIV epidemic increases. However, early vaccines on the market are likely to be only partially effective, and post-vaccination increases in risk behavior (i.e., risk compensation (Hogben & Liddon, 2008)) could reduce the public health benefit (Andersson et al., 2007; Blower, Schwartz, & Mills, 2003; Eaton & Kalichman, 2007; Fonseca et al., 2010; Gray et al., 2003). Findings from previous studies examining individuals' likelihood of risk compensation have been mixed; when queried about others' behaviors, study participants reported a likely increase in sexual risk behavior if vaccinated (Koniak-Griffin, Nyamathi, Tallen, González-Figueroa, & Dominick, 2007; Newman et al., 2009; Newman, Roungrakphon, Tepjan, Yim, & Walisser, 2012; Olin et al., 2006; Sayles, MacPhail, Newman, & Cunningham, 2010; Webb, Zimet, Mays, & Fortenberry, 1999). However, when asked about personal behaviors, relatively few anticipated engaging in such risk compensation (Barrington, Moreno, & Kerrigan, 2008; Crosby & Holtgrave, 2006; MacPhail, Sayles, Cunningham, & Newman, 2012; O'Connell et al., 2002). These seemingly incongruous findings indicate a need for a more nuanced understanding of risk compensation related to HIV vaccination. Risk compensation is inherently a relationship-level, or dyadic, phenomenon, yet most existing studies employed only global measures (i.e., inquiring about individuals' likelihood of changing their risk behavior in general). These global measures determine *who* is most likely to increase risk behavior but not *the types of relationships* in which behavioral change is likely to occur. This presents a significant gap in knowledge about the potential impact of risk compensation on HIV vaccine initiatives.

Recent network-level research using dyadic data on anticipated HIV vaccine-related risk compensation revealed that increases in risk behavior in certain relationships could impact the connectivity of the overall risk network in which individuals are embedded (Young, Halgin, DiClemente, Sterk, & Havens, 2014). While the study focused on the larger network structure, local dyadic patterns remained largely unexplored. Therefore, the purpose of the present study was to characterize the dyadic relationships in which HIV vaccine-related risk compensation is most likely to occur.

Methods

Sample

The sample consisted of 433 participants enrolled in a longitudinal study investigating HIV, HCV, and herpes-simplex 2 incidence among illicit drug users [described in detail elsewhere (Havens et al., 2013; Young, Jonas, Mullins, Halgin, & Havens, 2013)]. Eligibility criteria included being at least 18 years of age, residing in Appalachian Kentucky, and having used prescription opioids, heroin, crack/cocaine or methamphetamine "to get high" in the prior 30

days. Participants completed interviewer-administered questionnaires and HIV testing at baseline and in 6-month intervals thereafter. A questionnaire to examine attitudes toward HIV vaccination and risk compensation intent was administered during participants' 24-month assessment; the data from this questionnaire were used for the analyses presented below. Details on the HIV vaccine survey methods have been described previously (Young, DiClemente, Halgin, Sterk, & Havens, 2014a, 2014b; Young, Halgin, et al., 2014). All participants tested HIV negative at the 24-month visit. The protocol was approved by the University Institutional Review Board and a Certificate of Confidentiality was obtained.

Dyadic data

Respondents were asked to provide the first name and last initial of individuals with whom they had injected drugs and/or engaged in sex during the past 6 months. Each partnership constituted a 'risk relationship'. As described elsewhere (Young, Halgin, et al., 2014), for each partner, respondents were asked about their likelihood of increasing risk behavior if they, the partner, or they *and* their partner received an HIV vaccine. Specifically, respondents were asked three sex-related items, "If [you/partner/you and partner] got an HIV vaccine that was 90% effective, would you use a condom with them... ['Much less often', 'Less often', 'More often', 'Much more often', 'We wouldn't change how often we used a condom']"; and three injection-related items, "If [you/partner/you and partner] got an HIV vaccine that was 90% effective, would you use share injection equipment..." ['Much less often', 'Less often', 'More often', 'Much more often', 'We wouldn't change how often we shared equipment']. Using these data, a binary **risk compensation** variable was created in which the value of 1 was assigned to risk relationships with anticipated increases in risk behavior in any one of the above six items and 0 if otherwise.

Additional variables included gender similarity (binary), absolute difference in age (years), duration of relationship (years), frequency of communication (6-point Likert scale, with increasing values representing more frequent communication), geographic distance between residences (9-point Likert scale with increasing values indicating farther distances), trust (10-point scale), and whether the respondent received social and/or financial support from each partner (both binary). Participant and partner gender, age, and recent (past 6 month) injection drug use (binary) as reported by the respondent, were also analyzed.

Behavioral dyadic measures included engagement in the following behaviors with each partner: used drugs, injected drugs, injected drugs *and* had sex, and distributive and/or receptive sharing of injection equipment. Frequency of risk behavior was examined using a variable representing the sum of three Likert scales on which participants rated the frequency of unprotected sex (4-point scale) and needle and cooker sharing (5-point scales) with the partner. Perceived risks and benefits are key to the theoretical foundation of risk compensation (Eaton & Kalichman, 2007; Hogben & Liddon, 2008; Wilde, 1982). Risk perceptions were assessed using the following: "How likely do you think it is that [partner] would ever get infected with HIV?" and "How likely do you think it is that [partner] would ever infect you with HIV?" (4-point Likert scales ranging from "very unlikely" to "very likely"). Participants' perceived benefit of vaccination was assessed using the following: "In

your opinion, how much would an HIV vaccine benefit you?" [1=not at all, 2=a little, 3=some, 4=a lot].

Statistical analyses—Given potential autocorrelation among dyads involving the same respondent, generalized linear mixed models with a random effect for respondent were used. Models were estimated using the PROC GLIMMIX (SAS Institute, 2011) procedure (SAS v9.3). Anticipated risk compensation was regressed on each of the key measures described above. Covariates reaching $p < 0.10$ in bivariate analyses were entered into multivariate analyses. Unadjusted and adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were reported.

Results

Sample demographic and behavioral characteristics have been reported elsewhere (Young, DiClemente, et al., 2014a, 2014b; Young, Halgin, et al., 2014). Participants were predominantly White (94%), male (55%), and unmarried (75%). The median age was 34 years (range: 21–68). Most (82%) reported at least one sexual partner in the past 6 months, 24% reported having multiple partners, 71% reported unprotected sex with at least one partner, and 20% reported unprotected sex with a person who injects drugs. Characteristics of risk partnerships are presented in Table 1. The risk network contained 582 relationships; 78% were sexual only, 12% involved injecting together, and 10% involved injection and sex. There were 30 relationships in which a respondent reported anticipated risk compensation; three anticipated increases in equipment sharing and 27 in unprotected sex.

Dyadic correlates to likelihood of risk compensation

Table 1 describes bivariate analysis of dyadic correlates of intended risk compensation. Risk compensation was more likely to occur between partners who inject drugs *and* have sex together ($p = 0.039$) and in partnerships of shorter duration ($p = 0.028$). Among relationships involving risk compensation, 37% were in existence for a year or less compared to only 13% of relationships not involving risk compensation. In multivariate analysis (Table 2), only relationship duration ($p = 0.046$) was significantly associated with risk compensation intent. For every one-year increase in relationship duration, the odds of risk compensation decreased by 5% (OR: 0.95; CI: 0.90–1.00; $p = 0.033$).

Discussion

While some studies have examined individual-level correlates to risk compensation, few have characterized the types of relationships in which risk compensation is most likely to occur. This gap is significant given that different types of risk relationships pose different levels of HIV transmission risk (Baggaley, Boily, White, & Alary, 2006; Boily et al., 2009). Although risk compensation in our study was relatively uncommon, results suggest that risk compensation was more likely to occur in what could be considered as less established relationships (i.e., relationships of shorter duration). In bivariate analyses, participants were also more likely to engage in risk compensation with partners with whom they had a multiplex risk relationship and to a lesser extent, with partners who they perceived to be at a higher risk for HIV. While seemingly counterintuitive, the increased likelihood of risk

compensation in more ‘risky’ partnerships is consistent with the cognitive mechanism underlying risk compensation (Hogben & Liddon, 2008) and relevant to risk calibration (Eaton & Kalichman, 2007). Inhibition is a necessary prerequisite for disinhibition; that is, increased risk behavior would only be expected to occur in those relationships originally perceived as posing a risk.

If risk compensation is most likely to occur in the relationships that present the greatest HIV transmission risk, then risk compensation could pose a greater threat for HIV acquisition than that projected from global measures of anticipated behavior change. More advanced mathematical modeling and simulation is needed to fully explore this possibility. To our knowledge, this is the first study of its kind to identify relationship-level correlates to risk compensation using dyadic analyses. Thus, similar research in different settings and at-risk groups is needed to determine if trends observed in this sample of drug users is consistent with those that can be anticipated in other settings. Overall, these findings emphasize the importance of acknowledging dyadic factors that might influence future risk behaviors and have important implications for vaccine program planning.

Limitations of the present study are described in detail elsewhere (Young, Halgin, et al., 2014), and include factors such as reliance on self-report, measures based on intention rather than actual behavior, and cross-sectional study design. Nevertheless, our findings provide further support for the need to expand measures of risk compensation in HIV vaccine preparedness studies to assess not only *if* people will change their behavior, but also *with whom*.

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Table 1

Bivariate correlates to risk compensation intent in 582 risk relationships

	Risk Compensation (n=30)	No risk compensation (n=552)	OR (95% CI)	p-value
Demographic similarities				
Same gender	1 (3.3)	76 (13.8)	0.23 (0.02 – 2.26)	0.209
Age difference ¹ (years)	5.4 (5.0)	7.0 (6.7)	0.97 (0.90 – 1.04)	0.344
Relationship characteristics				
Duration (years)	6.3 (7.3)	10.4 (8.8)	0.95 (0.90 – 0.99)	0.028*
Frequency of contact	5.0 (1.2)	5.4 (1.0)	0.86 (0.60 – 1.23)	0.404
Distance ²	4.4 (2.9)	4.0 (2.7)	1.00 (0.86 – 1.17)	0.973
Trust	6.1 (3.4)	6.5 (3.2)	1.03 (0.92 – 1.15)	0.625
Social support	13 (43.3)	265 (48.0)	0.98 (0.38 – 2.56)	0.968
Receives financial support	11 (36.7)	218 (39.5)	1.34 (0.57 – 3.15)	0.507
Partner's risk for HIV ³	2.3 (0.7)	1.9 (0.9)	1.40 (0.99 – 1.99)	0.055
HIV risk posed by partner ³	1.9 (0.7)	1.6 (0.8)	1.38 (0.83 – 2.28)	0.215
Behavior				
Used drugs together	17 (56.7)	348 (63.0)	0.88 (0.40 – 1.96)	0.757
Sexual relationship (Ref: inject together only)	29 (96.7)	482 (87.3)	4.15 (0.41–41.76)	0.227
Inject together <i>and</i> sexual partners	6 (20.0)	54 (9.8)	2.52 (1.05 – 6.04)	0.039*
Distributive needle sharing	2 (6.7)	40 (7.3)	0.86 (0.13 – 5.66)	0.871
Receptive needle sharing	2 (6.7)	37 (6.7)	1.05 (0.19 – 5.78)	0.955
Frequency of risk behavior	2.1 (2.6)	2.6 (1.9)	0.93 (0.69 – 1.26)	0.652
Respondent characteristics				
Male	21 (70.0)	316 (57.3)	1.20 (0.47 – 3.07)	0.698
Age	33.3 (5.2)	33.1 (8.0)	1.02 (0.98 – 1.06)	0.446
Recent injection drug use	16 (53.3)	257 (46.6)	1.55 (0.61 – 3.97)	0.359
Perceived benefit of HIV vaccination			1.47 (0.88 – 2.45)	0.138
Partner's characteristics				
Male	10 (33.3)	248 (44.9)	0.80 (0.31 – 2.09)	0.649
Age ²	31.4 (9.6)	34.0 (9.6)	0.99 (0.94 – 1.03)	0.593
Recent injection drug use	11 (36.7)	194 (35.1)	1.14 (0.50 – 2.57)	0.762

* p < 0.05; OR: odds ratio; CI: confidence interval

¹ Due to two missing values among those not intending risk compensation, 580 relationships were included in analysis.² Due to three missing values among those not intending risk compensation and one among those intending risk compensation, 578 relationships were included in analysis.³ Due to one missing value among those not intending risk compensation, 581 relationships were included in analysis.

Table 2

Multivariate correlates to risk compensation intent in 581 risk relationships

	Adjusted OR (95% CI)	p-value
Relationship characteristics		
Duration (years)	0.95 (0.90 – 1.00)	0.033 [*]
Partner's risk for HIV ^{<i>l</i>}	1.34 (0.95 – 1.90)	0.096
Behavior		
Inject together <i>and</i> sexual partners	2.08 (0.82 – 5.23)	0.119

^{*} p < 0.05; OR: odds ratio; CI: confidence interval

^{*l*} Due to one missing value among those not intending risk compensation, 581 relationships were included in analysis.