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ORIGINAL PAPER

Linking Syndemic Stress and Behavioral Indicators of Main Partner HIV Transmission Risk in Gay Male Couples

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Abstract The purpose of the current study was to examine whether syndemic stress in partnered gay men might undermine communication processes essential to the utilization of negotiated safety and other harm reduction strategies that rely on partners' HIV status disclosure. Participants included 100 gay male couples ($N = 200$ individuals) living in the U.S., who responded to an online survey. Participants completed measures of five syndemic factors (depression, poly-drug use, childhood sexual abuse, intimate partner violence, and sexual compulsivity). They also reported on whether condoms were used during first intercourse together and the timing of first condomless anal intercourse (CAI) relative to HIV disclosure in their relationship. Results of binary logistic regression analyses supported the hypothesis that the sum of partners' syndemic stress was negatively associated with condom use at first intercourse and with HIV disclosure prior to first CAI. Syndemic stress may contribute to HIV transmission risk between main partners in part because it accelerates the progression to CAI and interferes with communication processes central to harm reduction strategies utilized by gay men in relationships. Implications for prevention strategies and couples interventions, such as couples HIV counseling and testing, that facilitate communication skill-building, are discussed.

Keywords Gay and bisexual men · Same-sex relationships · Sex risk · Communication · Syndemics

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Introduction

Gay and bisexual men continue to make up the majority of new HIV cases in the United States, with recent estimates indicating that 78 % of new HIV infections among males are attributed to same-sex sexual activity [1]. In recent years, research on HIV risk among gay and bisexual men has undergone a shift in focus in response to the publication of studies which estimated that 32–68 % of new HIV infections among gay and bisexual men occur between individuals who identify as main partners at the time of infection [2, 3].

In response to these findings, innovative HIV prevention efforts are emerging. WHO has issued guidance for couples HIV testing and counseling (CHTC) [4], which has been used effectively with heterosexual couples in Africa [5–8]. Findings suggest this is a promising strategy for prevention among same-sex male couples [9, 10]. In response, the CDC has endorsed the intervention approach [11] and is currently engaged in implementation efforts in the US.

Previous research is scarce concerning the various means by which HIV might be introduced into a previously seroconcordant-negative relationship. Within main partnerships, HIV may be transmitted by a partner who was HIV-positive at the relationship's outset or who has become HIV-positive during the relationship due to condomless anal intercourse (CAI) with a casual partner. One study of 35 serodiscordant gay male couples found that

only 69 % were discordant upon relationship initiation [12]. Thus, new HIV infections introduced into a relationship by outside partners (whether by "cheating" or through an open relationship) could represent significant sources of infections transmitted between main partners.

Accordingly, accurate knowledge of one's HIV status, and adequate skills and willingness to communicate with one's partner about each other's status and about ways to minimize risk prior to engaging in CAI, are paramount in the prevention of HIV transmission within couples. These factors (awareness of HIV status and communication about risk management) constitute the mechanism by which CHTC is hypothesized to enhance sexual safety in main partnerships. During a CHTC session, partners within a couple discuss their sexual agreement, make a plan to manage HIV risk together going forward, and also learn each other's status.

HIV knowledge and risk communication also play a critical role in couples' harm-reduction strategies. Perhaps the most studied of these strategies is *negotiated safety*, which refers to a couple discussing their HIV statuses and establishing rules for allowing condomless sex within the relationship while requiring condom use with any outside sex partners [13–15]. While some authors have utilized the term negotiated safety to imply the existence of a monogamous agreement between partners (e.g., Kippax et al. [16]), negotiated safety does not necessarily entail monogamy. While monogamy is a common component of negotiated safety, couples who are sexually open or "monogamish" (i.e. sex with outside partners only when both main partners are present, such as threesomes [17]) may be considered to have negotiated safety as long as they agree to use condoms with outside partners [16]. Having a negotiated safety agreement has been found to predict vastly reduced odds of having unprotected casual sex outside the relationship [16]; however, Kippax et al. [16] emphasized that the effectiveness of a negotiated safety agreement depends upon clarity, honesty, testing, trusting, and communicating.

Despite the importance of partners' HIV status knowledge and communication about risk management for couples' HIV risk reduction, research examining these two processes has indicated that many partnered gay men may frequently fail to engage in these processes. With regard to status disclosure, research suggests that a substantial number of gay men do not discuss HIV status with their main partners. Sullivan [18] estimated that 67–88 % of HIV-positive men disclosed their status to primary sex partners. Mitchell [19] found that partners agreed that HIV status disclosure occurred prior to first sex in only 67 % of couples. Mitchell's findings also point to the potential for discrepancies in partner perceptions of status disclosure. Twelve percent of couples agreed that first sex occurred before HIV disclosure, while 21 % disagreed on whether such disclosure occurred.

As yet, no framework has been proposed to organize factors which diminish or threaten HIV status disclosure and communication about HIV risk management. Syndemics theory has been proposed as a framework for understanding how co-occurring individual risk factors interact to magnify the vulnerability of certain minority populations to adverse health outcomes [20]. Stall et al. [21] applied syndemics theory to the study of HIV risk in men who have sex with men (MSM). Their study focused on four syndemic factors—poly-drug use, depression, childhood sexual abuse, and intimate partner violence—and concluded that the number of syndemic factors was associated with likelihood of HIV infection and HIV risk. Parsons et al. [22] provided evidence for the inclusion of sexual compulsivity as a fifth syndemic factor driving HIV risk among MSM.

While no studies have specifically examined the effects of syndemic stress for couples in a comprehensive way, some dyadic research on gay couples has addressed syndemic factors individually. These studies suggest that the syndemics framework may be useful in organizing factors which enhance vulnerability for HIV infection in gay couples. In a study of 172 gay male couples, Starks, Grov, and Parsons [23] found that sexual compulsivity was negatively associated with sexual communication as well as sexual satisfaction. Furthermore, Starks et al. [23] reported that the number of casual male CAI partners was positively correlated with a participant's own sexual compulsivity score, and also with their partner's as well. Regarding drug use, Parsons and Starks [24] observed significant interdependence of drug use between partners of gay male couples. Furthermore, higher drug use was associated with relationship sexual arrangements (e.g. monogamous, open, etc.) that have been determined to be riskier in terms of sexual risk taking [24]. In another study, Gamarel et al. [25] found that, among serodiscordant gay male couples, depression in HIV-positive partners was a strong predictor of decreased odds of viral suppression—viral suppression being strongly associated with decreased likelihood of transmission [26, 27]. Though this research represents a promising start, no existing studies have comprehensively examined dyadic effects of syndemic stress in a manner that addresses all five identified syndemic factors.

The Current Study

To the extent that syndemic stress inhibits effective disclosure of HIV status and communication about safety practices and sexual agreements prior to CAI between

partners, it impairs the utilization of negotiated safety and undermines processes that are central to CHTC. Accordingly, the purpose of the current study was to examine whether syndemic stress might undermine communication processes essential to the utilization of negotiated safety and other harm reduction strategies that rely on partners' HIV status disclosure. Specifically, we hypothesized that high levels of syndemic stress would decrease the likelihood of using condoms the first time a couple has sex and of reporting HIV status disclosure prior to the first event of CAI.

Methods

Participants

Eligible participants included biological men who identified as male were 18 or older, and reported being in a primary romantic relationship or partnership with another biological man who was 18 or older. Responses were limited to relationships in which both members of the couple completed the study and reported an HIV-negative serostatus. In total, the online survey was opened 682 times. Of these, 467 (68.5 %) surveys were completed by unique individuals. These included 270 HIV-negative or unknown status index participants. Of these, 101 (37.4 %) successfully recruited their partners. One of these couples was excluded because the recruited partner reported an HIV-positive serostatus. A detailed comparison of index cases who successfully recruited their partner, with those who attempted to recruit their partner but were unsuccessful, and those who refused to recruit their partner has been published elsewhere [42].

Demographic information for the sample is reported in Table 1. Average age of participants in the sample was 31.2 years ($SD = 9.9$). The majority identified as White (72.0 %) and had completed a 4-year college degree or more (bachelors, or graduate degree; 70.5 %). Approximately half of the sample (47.5 %) earned more than $40,000 individually, annually. Where members of the same dyad reported different relationship length, an average of their reports was used. The majority of participants ($n = 77$ couples; $n = 154$ individuals) reported that they live in or visited the NYC metropolitan area regularly. With regard to geographic location, 164 participants reported living in the Northeastern United States, 10 (5 %) in the Midwest, 11 (5.5 %) in the South, and 13 (6.5 %) in the West.

The mean relationship length was 60.9 months ($SD = 76.3$; range 2–468). Relationship length was truncated at the 95th percentile to correct for deviations from normality. This resulted in six couples with relationship length greater than 201 months being assigned values of 201–206 to preserve their rank order in analyses. After truncation, the mean of relationship length was 56.1 months ($SD = 59.5$; range 2–206), or approximately 4.7 years. Sensitivity analyses suggested that model results achieved from the truncated and untruncated variables did not differ in parameter magnitude or statistical significance.

Procedure

Data were collected between December 2011 and February 2013, using an internet-based survey host. Index participants were recruited through a variety of mechanisms involving online and in-person venues. Online recruitment activities included the distribution of study information via listservs and websites targeting the MSM community. Online recruitment materials were also sent to partnered MSM who had completed or were ineligible for participation in other studies and indicated an interest in future studies. Online recruitment materials contained a direct link to the survey. Participants who clicked on the link were directed to a page containing detailed informed consent information. After viewing this information, potential participants verified that they were 18 years of age or older, had viewed consent information, and agreed to participate in the survey before proceeding to study items. Online recruitment efforts were supplemented by in-person recruitment activities included attendance by study staff at community and social events frequented by MSM in the New York City area. A small number of potential participants ($n = 21$) were identified after completing their participation in another survey research project.

The online survey utilized an "index case" approach to the recruitment of couples. Index participants accessed the study link through any of the recruitment methods described above. After providing personal contact information, index participants were given the option to refer their partners to the study by providing their partners' contact information. When index participants chose to refer their partners, the survey generated an automatic email, which participants were allowed to modify prior to sending. Participants were compensated both individually and as a couple. Any participant who completed the survey and included their mailing addresses received a free movie ticket. Couples in which both index and referred partners completed the survey were also entered into a raffle to receive additional $100 compensation. The raffle prize was given to one in every 25 completed couples. All recruitment materials and procedures were approved by the IRB at Hunter College.

Table 1 Individual demographic characteristics and partner interdependence

Demographics	Total $n = 200$	Interdependence
	M (*SD*)	ICC
Age (years)	31.2 (9.9)	0.74**
	n (%)	κ
Race and ethnicity		0.10
White/European	144 (72.0)	
Black/African American	6 (3.0)	
Latino	25 (12.5)	
Other	25 (12.5)	
Education		
Less than a 4 year college degree	59 (29.5)	0.16
4 year college degree or more	141 (70.5)	
Annual income		
Less than $40,000	105 (52.5)	0.46**
$40,000 or more	95 (47.5)	
Endorsed presence of syndemic factor		
Depression	70 (35.0)	0.25**
Intimate partner violence (past or present)	81 (40.5)	0.40**
Poly-drug use	39 (19.5)	0.40**
Childhood sexual abuse[a]	32 (16.0)	0.27**
Sexual compulsivity	19 (9.5)	.01
Total syndemic factors endorsed[a]		0.16**
None	68 (34.0)	
1	65 (32.5)	
2	34 (17.0)	
3	18 (9.0)	
4 or 5	11 (5.5)	

[a] Variable has missing data

** $p < 0.01$

Measures

Demographics

Participants indicated their age, sexual identity, race and ethnicity, HIV serostatus (positive, negative, unknown), education level, and individual income level. Participants also provided information related to the duration of relationship (in months).

Depression

Participants completed the depression subscale of the Brief Symptom Inventory [28]. Participants indicated how much they were distressed by each of six symptoms on a Likert-type scale from 1 (*not at all*) to 5 (*extremely*). The scale demonstrated strong reliability ($\alpha = 0.91$). Consistent with manual recommendations [29] and the work of others [30, 31], a clinical cutoff was used to dichotomize scores. Participants were indicated to have clinically significant symptoms of depression if they had a T score of 65 or greater calculated using the adult nonpatient norms for males. Those with a T score of less than 65 were below the clinical cutoff.

Childhood Sexual Abuse

The occurrence of childhood sexual abuse was assessed using two items published in previous research [32, 33]. These items were, (1) "Thinking back from your childhood to the present, have you ever been forced or frightened by someone into doing something sexually that you did not want to do?" and (2) "Sometimes people's views about their experiences change over time. Did you ever have an experience when you felt at the time that you were forced or frightened into doing something sexually that you did not want to do?" Participants who responded "yes" to either of these items were then asked to report the age at which the sexual experience occurred. Participants were classified as reporting childhood sexual abuse if they

responded "yes" to either of the two sexual experience questions and reported the experience occurred when they were younger than age 18. Participants were classified as not reporting childhood sexual abuse if they reported "no" to both of the sexual experience items, or if they reported "yes" to either of the two items but indicated their age was 18 or greater at the time of the sexual experience.

Poly-Drug Use

Participants reported whether or not they had used any of the following substances in the past 3 months: cocaine, crystal methamphetamine, ecstasy, gamma-hydroxybutyrate, ketamine, marijuana, heroin, and poppers. In order to operationalize poly-drug use, responses were aggregated into a single dichotomous variable indicating whether the participant used two or more of any substance in the previous 3 months.

Intimate Partner Violence

The occurrence of intimate partner violence was assessed using a modified version of the partner violence questionnaire [21, 34, 35]. Men were asked to indicate whether or not any partner in the previous 5 years had committed any of a list of 12 acts (e.g., "Has any partner in the past 5 years ever verbally threatened you in any way?"). Responses were aggregated to create a single dichotomous variable indicating whether any of the 12 acts had occurred. Those participants reporting at least one act were coded "1" and those reporting no acts were coded "0."

Sexual Compulsivity

Sexual Compulsivity was measured using the Sexual Compulsivity Scale (SCS) [36, 37]. The SCS is a 10-item, 4-point Likert-type scale that assesses distress and dysregulation of sexual, desire, and/or behaviors as well as the impact of this distress and dysregulation on adaptive functioning. SCS total scores ranged between 10 and 40 ($M = 18.16$, $SD = 6.44$) with higher scores indicating a greater degree of sexual compulsivity symptoms ($\alpha = 0.89$).

Condom Use at First Sex

Participants were asked a single question about condom use at first sex: "The first time you had sex with your main partner, did you use a condom?" Participants responded either "yes" or "no." Couples were coded as having used condoms during first sex if both members of the couple indicated that condoms were used. If either member of the couple reported condoms were not used during first sex, the couple was coded as not having used them.

Main Partner HIV Status Disclosure

Participants were asked a series of questions related to the occurrence of CAI in their current relationship. Participants were asked if they used condoms the first time they had sex with their current partner (response options "yes/no"). Participants who reported condom use during first intercourse with their current partner were subsequently asked "How long did you and your partner use condoms before stopping?" Response options included: "Not applicable, we never stopped using condoms," "1 week," "2–3 weeks," "1 month," "2–3 months," "4–6 months," "7–12 months," or "more than a year."

Participants were also asked about HIV status disclosure relative to the timing of condomless sex (if it occurred) within their relationship. Participants were first asked whether they had told their main partner their HIV status. Response options included, "Yes," "No," and "No, because I do not know my status." Participants who reported telling their partner about their status were asked about when this disclosure occurred. Response options included, "before we ever had anal sex," "after we had anal sex but before we stopped using condoms," and "after we had anal sex without a condom for the first time." Participants were then asked what their partners had told them about their HIV status. Response options included, "My partner told me he was HIV-positive," "My partner told me he was HIV-negative," "My partner told me he does not know his status", and "My partner has never told me his HIV status." Participants who reported that their partner disclosed HIV status were then asked about when this disclosure occurred. Response options included, "before we ever had anal sex," "after we had anal sex but before we stopped using condoms," and "after we had anal sex without a condom for the first time."

Responses to sexual behavior and HIV status disclosure variables were used to create a series of dichotomous variables. These variables identified participants who reported personal violations of HIV status disclosure and partner violations of HIV status disclosure. Personal violations of HIV status disclosure were indicated any time a participant reported that CAI occurred before he personally informed his partner of his own HIV status. Partner violations of HIV status disclosure were indicated any time a participant reported that CAI occurred before his partner revealed his HIV status. These variables were used to examine similarities and correspondence between partners' perceptions of communication. They were also combined to create a single variable indicating whether a participant reported the presence/absence of any violation (personal or partner) of HIV status disclosure.

Results

The interdependence of partners' demographic characteristics was evaluated using the intra-class correlation for normally distributed variables and κ for categorical variables. Both of these statistics vary between −1.0 and 1.0 with large absolute values indicating a greater proportion of the variables variance is accounted for by couple membership. Examination of ICC and κ values indicated that couple membership accounted for a significant amount of variance in age and income as well as syndemic factors including depression, intimate partner violence, and polydrug use.

Reported Perceptions of Condom Use During First Sex and HIV Status Disclosure Prior to CAI

There was a high degree of agreement in partners' responses about the use of condoms during first sex. In 82 couples, partners agreed on the occurrence of condom use during first sex. In 19 of these couples (23 %), partners agreed that condoms were not used the first time they had sex. In 63 couples (77 %), partners agreed that condoms were used.

Similarly, there was a high degree of agreement in partners' reports of personal HIV status disclosure. In 91 couples, both members reported disclosing their status at some point in time, while one couple agreed that HIV disclosure had not occurred, and in eight couples one partner reported disclosing and the other reported not disclosing. In 82 couples, both members reported that their HIV disclosure occurred prior to CAI. In five couples, both members reported that they told their partner their HIV status only after CAI occurred. In 13 couples, one member reported HIV status disclosure prior to CAI while the other reported he told his partner after CAI.

Finally, congruence was evaluated by comparing reports of personal HIV status disclosure violations (i.e., a participant's response indicating that CAI occurred before he disclosed his own HIV status to his partner) with reports of partner HIV status disclosure violations (i.e., a participant's response that CAI occurred before his partner told him his HIV status). In 91 couples, personal reports of disclosing HIV status prior to CAI matched partner perceptions that such a disclosure occurred. In 80 couples, each member reported HIV status disclosure prior to CAI and also that his partner disclosed HIV status prior to CAI. In an additional four couples, both members reported that they did not disclose HIV status prior to CAI and also that their partners did not disclose HIV status prior to CAI. For these 84 couples, responses indicate perfect similarity and complete agreement about the occurrence and timing of reported and perceived disclosure. Of the 16 remaining couples, seven had perfect congruence but differed on disclosure. In other words, "partner A" disclosed HIV status prior to CAI and this was perceived accurately by "partner B;" meanwhile, "partner B" did not disclose his HIV status to "partner A" and "partner A" agreed that the disclosure did not occur. In six couples, one member reported disclosing HIV status prior to CAI, but his partner did not report perceiving the disclosure. In three couples, one member reported that he did not tell his partner his HIV status prior to CAI, but his partner reported perceiving this disclosure occurred.

Total Syndemic Stress Scoring

The first step in multivariate analysis was to evaluate the appropriateness of utilizing a sum score to quantify syndemic stress using procedures identified by Starks et al. [43]. A small number of participants ($n = 4$) were missing data related to childhood sexual abuse. In all analyses, missing data were handled using full information maximum likelihood estimation. Results provided support for the use of a summary syndemic stress score. The Wald test of parameter constraints yielded a non-significant result ($\chi^2(4) = 0.63$, $p = 0.96$) suggesting that constraining factor loadings to be equal did not significantly diminish model fit. Based upon these results, a sum score was created by adding up participant's values on all five dichotomous syndemic factors (see Table 1). In order to create couple-level predictors appropriate for use in proposed models, total syndemic scores for each partner were added together to create an overall syndemic stress score for the couple. In order to account for the fact that, within couples, some participants differed from their partners and others were very similar, we also created a syndemics difference score, by subtracting the number of syndemic factors reported by the partner with the fewest factors from the number reported by the partner with the most factors.

Syndemic Stress and Condom Use During First Sex

Results (unstandardized and exponentiated regression coefficients as well as confidence intervals) of a binomial regression model predicting condom use at first intercourse are presented in Table 2. Only the total syndemic stress variable was significantly associated with the odds of condom use during first sex. The size of this effect was moderate ($\beta = 0.39$). Couples with higher syndemic stress were less likely to have used a condom the first time they had sex. Couple age, education, race and relationship length were unrelated to condom use during first sex.

Table 2 Syndemic stress and condom use at first sex

	B	95 % CI	exp β
Syndemic stress			
Total	−0.40**	(−0.72, −0.07)	0.67
Difference	0.13	(−0.53, 0.79)	1.14
Age			
Younger partner	−0.02	(−0.10, 0.6)	0.98
Age difference	−0.03	(−0.12, 0.06)	0.97
Race (ref = any partner non-White)	−0.57	(−1.53, 0.39)	0.57
Education (ref = any partner <4 year degree)	−0.03	(−0.99, 0.93)	0.97
Relationship length	−0.01	(−0.02, 0.01)	1.00

* $p \leq 0.05$

** $p \leq 0.01$

Table 3 Syndemic stress and HIV status disclosure prior to CAI

	B	95 % CI	exp β
Syndemic stress			
Total	−0.53**	(−0.94, −0.12)	0.59
Difference	0.44	(−0.43, 1.31)	1.55
Age			
Younger partner	0.03	(−0.06, 0.13)	1.03
Age difference	−0.06	(−0.16, 0.05)	0.94
Race (ref = any partner non-White)	0.78	(−0.63, 2.19)	2.18
Education (ref = any partner <4 year degree)	−1.46*	(−2.73, −0.18)	0.23
Relationship length	−0.02**	(−0.04, −0.01)	0.98

* $p \leq 0.05$

** $p \leq 0.01$

Syndemic Stress and HIV Status Disclosure Prior to First CAI

Results of a binomial regression model predicting HIV status disclosure prior to first CAI are provided in Table 3. Total syndemic stress was significantly associated with the odds of HIV status disclosure prior to first CAI. The size of this effect was moderate ($\beta = 0.44$). Those couples with more syndemic stress were less likely to have discussed HIV status prior to CAI. Couples in which both members had earned at least a 4 year degree, and couples who reported longer relationship length were also less likely to have discussed HIV status prior to first CAI. Couple age and race were unrelated to condom use during first sex.

Discussion

Results from this study supported hypotheses that syndemic stress would be associated with behaviors that enhance HIV transmission risk within main partner relationships. The total syndemic stress experienced by the partners in a couple was negatively associated with condom use during first sex and with disclosure of HIV status prior to first CAI. A couple with high levels of syndemic stress was more likely to not use condoms when they initiated sex together, and was also less likely to have talked about their HIV status prior to the first time they had CAI. While all men in this study self-reported an HIV-negative status, these kinds of behaviors increase their vulnerability to contracting HIV from main partners if either member of the couple was incorrect about his HIV status.

These results are consistent with previous research which indicated that CAI often occurred early in relationships and often prior to HIV disclosure. Davidovich el al. [38] found that among gay men who had had CAI in their relationship, more than one-third had it within the first month of the relationship. Furthermore, nearly half (46 %) of these men had CAI without discussing it first. Given that CAI may occur early and without prior discussion, establishing HIV-negative seroconcordance prior to condom cessation is an essential component of couples' HIV prevention efforts. However, this mutual disclosure may not always take place. In a study of London gay men [4, 39]

4.3 % of the respondents who reported CAI with only their main partner (thus fulfilling one criterion of negotiated safety) did not know their own HIV status or the status of their partner. They therefore did not fulfill the other criterion of negotiated safety—establishing negative seroconcordance.

Participants' reports of HIV status disclosure and perceptions of their partners' disclosure prior to CAI illustrate a number of ways in which breaches of communication may introduce risk into relationships. One potential mechanism suggested by data in the current study was a failure of disclosure. In 11 couples, at least one member did not tell his partner his HIV status before they had CAI and his partner agreed that the disclosure did not occur—in four of these couples, both members did not disclose, and in seven couples, one disclosed and one did not. A second possible vehicle for risk illustrated by these data was a failure of perception. In six couples, one member reported disclosing HIV status prior to CAI but his partner did not report perceiving this disclosure. In three others, one member reported perceiving HIV status disclosure prior to CAI but his partner did not report making this disclosure.

Of the possibilities for infection listed above, nearly all involve communication (or lack thereof) between partners—whether communication of serostatus, sexual agreements, or violations of these agreements. Therefore, given the centrality of inter-partner communication to the successful utilization of negotiated safety, understanding factors that interfere with this communication process remains a significant goal for HIV prevention in male couples. These results provide strong support for couples-based HIV prevention interventions that facilitate direct communication including explicit disclosure of HIV status. Interventions such as CHTC may be particularly useful for couples in which one member has experienced high levels of syndemic stress. The public health impact of such interventions might be enhanced by specifically targeting populations at risk of experiencing multiple syndemic stressors (e.g., substance users, individuals seeking mental health care).

While no demographic factors were associated with couples' likelihood of not using condoms at first sex, both higher levels of education (in both members of the couple) and longer relationship duration were associated with being less likely to have discussed HIV status prior to first CAI. The finding that longer relationship duration was associated with behavior that confers increased HIV transmission risk is consistent with observations by others [2, 3] linking relationship length and the probability of main partner HIV transmission. However, this finding must also be viewed in light of relationship length. It is possible that older couples are more likely to have forgotten discussions of HIV status prior to first CAI. Longitudinal research, which follows individuals through the process of relationship formation and the initiation of intercourse, is needed in order to reduce the potential influence of recall. The finding that higher educational attainment was associated with lower odds of HIV status disclosure prior to CAI may arise in part from risk perceptions. While higher levels of education are typically associated with increased HIV prevention knowledge [40], the fact that higher education is linked to decreased risk may mean that individuals with higher levels of education perceive themselves to be at lower risk of infection [41]. This decreased perception of risk may facilitate engagement in risk behavior for this group.

These findings should be viewed in light of several limitations. This study focused on a single aspect of couples' communication—the occurrence of HIV disclosure relative to the timing of CAI. Future studies may benefit from the incorporation of more broad assessment of individual communication skills and other aspects of dyadic communication processes. The generalizability of the findings may be limited by the sample being mostly White, well-educated, and from New York City. It is also unclear as to how the findings might apply to other groups at risk of experiencing multiple syndemic factors, such as lesbian or bisexual women, and transgender and gender non-conforming individuals. Also related to generalizability, the current study used an approach to quantifying syndemic stress which involved summing the number of syndemic factors that the participant indicated were present. While commonly used (e.g., Parsons et al. 2012; Stall et al. 2008), this approach to scoring does not fully explore potential associations between severity of impairment on individual syndemic factors and outcome. Finally, dyadic studies may over-sample couples with relatively better dyadic functioning [42], and thus under-represent poorer functioning couples for whom effective communication may be more difficult. Furthermore, the use of an index-case approach to referral opens the possibility that partners may communicate about the study prior to the referred partner's participation. An email referral process was utilized to minimize such communication.

Conclusions

This study is the first to apply syndemics theory to understand factors associated with main partner HIV transmission risk in gay couples. The findings indicate that the framework is useful in predicting the occurrence of key communication processes involved in couples' risk reduction strategies. Specifically, syndemic stress was negatively associated with the use of a condom during first sex and with the occurrence of HIV status disclosure prior to first CAI. These associations highlight the importance of

effective communication in establishing and maintaining negotiated safety between men in same-sex relationships. While the large majority of couples in this study were effective in their disclosure of HIV status prior to engaging in condomless sex, interventions focusing on improving communication during the earliest stages of relationship development may be critical to reducing main partner HIV transmission risk.

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