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Examining the longitudinal predictive relationship between HIV treatment outcomes and pre-exposure prophylaxis use by serodiscordant male couples

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Abstract

Background.—Men who have sex with men are disproportionately burdened by HIV/AIDS, and the advent of pre-exposure prophylaxis (PrEP) has provided an effective strategy to reduce the risk of HIV transmission. Research has shown that improving one partner's health-promoting behaviors increases the likelihood that their partner adopts healthier behaviors. We examined the longitudinal relationship between favorable HIV treatment outcomes with current PrEP use among HIV serodiscordant male partners.

Setting: Data are from Project Stronger Together, a randomized controlled trial that recruited serodiscordant male couples from Atlanta, GA, Boston, MA, and Chicago, IL.

Methods.—Serodiscordant couples completed assessments at baseline, 6, 12, 18, and 24 months. We analyzed longitudinal data from 120 HIV serodiscordant male partners to assess the relationship between the HIV-negative partner's current PrEP use and their HIV-positive partner's current ART use, ART adherence, and viral load using generalized estimating equation models.

Results.—Fewer than half of the HIV-negative partners were on PrEP at baseline and nearly two-thirds of their HIV-positive partners were virally suppressed. HIV-negative male partners who had partners with an undetectable viral load had greater odds of being a current PrEP user compared to HIV-negative partners with partners with a detectable viral load.

Conclusion.—Our study highlights the need develop dyad-level interventions to improve HIV medication use/adherence by HIV serodiscordant male couples. Our findings also suggest that dyad-level interventions may be able to leverage our understanding of how partners can influence each other's health-promoting behaviors to develop programs that improve health outcomes for both partners.

Keywords

men who have sex with men; serodiscordant; pre-exposure prophylaxis; antiretroviral therapy

INTRODUCTION

Men who have sex with men (MSM) are disproportionately impacted by the HIV/AIDS epidemic. In 2018, approximately 66% of all new HIV diagnoses given in the United States were to MSM,^{1,2} despite MSM only representing approximately 2% of the United States population.³ Public health efforts to reduce the transmission of HIV among MSM have largely focused on lowering the risk of acquiring HIV from casual sexual partners. Although much of the progress made since the beginning of the HIV epidemic has been credited to such strategies, the HIV incidence rate among MSM has not significantly decreased since 2008.⁴ Recent research has estimated that one-⁵ to two-thirds⁶ of new HIV infections among MSM occur within the context of primary partnerships, which highlights the need for more evidence-based HIV prevention interventions that focus on reducing the risk of HIV transmission between primary partners – especially for serodiscordant partnerships.

Combination antiretroviral therapy (ART) is used to suppress the HIV virus, to slow or stop the progression of the disease among people living with HIV/AIDS, and to reduce the risk of transmitting HIV to others.⁷ The randomized controlled trial HPTN 052 reported that in serodiscordant couples, the risk reduction attributable to ART use was approximately 96%.⁷ Although the current recommendation given by the Centers for Disease Control and Prevention is for HIV-positive individuals to immediately initiate and sustain ART use to lower their viral load, only 62.2% of HIV-positive individuals in the United States were estimated to be virally suppressed in 2017.⁸ Additionally, daily oral use of pre-exposure prophylaxis (PrEP) is an efficacious strategy to prevent HIV acquisition.^{9,10} The Centers for Disease Control and Prevention currently recommend PrEP for HIV-negative persons who are at high risk for HIV, including those with HIV-positive sexual partners.¹¹ While the protective benefits of PrEP have been well demonstrated, only approximately 15% of the 1.1 million adults in the United States who are indicated for PrEP have been prescribed PrEP.^{12,13} Understanding the factors that influence PrEP and ART use and adherence are essential to decreasing HIV transmission.

Dyad-level interventions designed to reduce HIV transmission risk among male couples are hypothesized to improve health outcomes for both partners by encouraging them to work

collectively toward common health goals, however, few dyad-level interventions tailored for the specific needs of male couples have been developed. Encouragingly, a recent study reported that 81.5% of MSM respondents expressed willingness to participate in HIV dyad-level interventions.¹⁴ A major priority of dyad-level interventions for MSM is improving HIV medication use and adherence. The health promoting behavior of medication adherence is very relevant to HIV serodiscordant same-sex male couples since both partners are recommended to be on HIV medication, and existing research suggests that improving one partner's health promoting behaviors increases the likelihood that their partner also adopts healthier behaviors.^{15,16} We are currently unaware of any studies that examine the longitudinal predictive relationship between HIV treatment outcomes and current PrEP use among HIV serodiscordant same-sex male partners. Given our understanding of how partners may have the ability to influence each other to adopt health-promoting behaviors, this study examines the longitudinal predictive relationship between current PrEP use among HIV-negative partners and their HIV-positive partners' current ART use, self-reported ART adherence, and viral load. We hypothesize that HIV-negative partners whose HIV-positive partner's have favorable HIV treatment outcomes have greater odds of currently using PrEP.

METHODS

Study Sample and Procedures

This study analyzed data collected by Project Stronger Together, a randomized controlled trial that examines the effect of combining couples' HIV counseling and testing (HCT) with ART adherence counseling to improve health outcomes for serodiscordant male couples.¹⁷ A total of 155 serodiscordant male couples (310 individuals) were recruited in Atlanta, GA, Boston, MA, and Chicago, IL from July 2014 through June 2017. Prospective couples were eligible to enroll in Project Stronger Together if they were: (1) two cis-gender men who had been in a relationship with each other for at least one month and who consider the other as their primary or only partner; (2) both at least 18 years old; (3) both residents of one of the three recruitment cities for at least 3 months; (4) reported no recent history (past 12 months) of intimate partner violence or coercion; and (5) HIV serodiscordant.

Participants were recruited from both online (e.g., Grindr, Facebook) and physical spaces (e.g., LGBT-oriented events, gay-themed venues) and were provided a link that directed them to an online screener and were asked to provide informed consent. Those who were eligible were then scheduled for their in-person baseline assessment. After completing their baseline assessment, couples were randomized into either the control arm, in which participants receive individual HCT, or the intervention arm, in which participants received couples HCT.

Couples were followed for 24 months with study assessments at baseline and 6, 12, 18 and 24 months. At each assessment, participants completed a questionnaire that collected data on demographics, information about their relationship, HIV care, HIV prevention, sexual behaviors, and injection drug use. Additionally, HIV medication drug adherence testing, and viral load testing were conducted.

For this analysis, we included only HIV-negative partners. HIV-negative partners who were not missing data on any of the variables included in the bivariate analyses from at least two study assessment were included in this study (n=120). For example, if a HIV-negative partner completed the baseline assessment and the 6-month assessment but their HIV-positive partner only provided viral suppression and/or self-reported ART adherence information at baseline and at the 12-month assessment, this HIV-negative partner would be excluded because he only has complete data for his baseline assessment as he did not have his partner's viral load data for the 6-month assessment and did not attend the 12-month assessment. A total of 35 participants were removed from the dataset due to missing data, 21 of whom were excluded due to missing data regarding their partner's HIV viral suppression and/or self-reported ART adherence.

Primary Exposures

The primary exposures were their HIV-positive partner's (1) current ART use, (2) self-reported adherence, and (3) viral load. The HIV-positive male partners' current ART use, ART adherence, and viral load were measured at every study assessment and were included as a time varying variable. The choice to include all three exposures was to provide readers the ability to compare how predictive commonly used HIV treatment measures are for PrEP use among HIV-negative partners.

Current ART use was assessed by asking participants: "Are you currently taking anti-HIV medications?", to which they responded by "yes" or "no".

Self-reported ART adherence was measured by prompting HIV-positive participants to "On the line below, please select the point that shows your best guess about how much of your prescribed HIV medication you have taken in the last month". The line presented ranged from 0%, meaning no medications were taken, to 100%, meaning every dose was taken. Responses were then re-categorized into the following groups: "100%", "90–99%", and "<90%".

Viral load was measured through laboratory testing. The HIV-positive male partner was considered to have an undetectable viral load if his viral load was <200 copies/mL and those with a viral load \geq 200 copies/mL were considered to have a detectable viral load.

Primary Outcome

Current PrEP use was assessed via self-report, which was asked at every study assessment. Participants were asked: "Are you currently using PrEP to prevent HIV?", to which participants responded by selecting "yes", "no", or "I don't know/can't remember". No participant chose "I don't know/can't remember".

Covariates

We evaluated three categories of independent variables in this analysis, (1) sociodemographic characteristics and (2) sexual behaviors. Sociodemographic variables included age (continuous), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic/Latino, and other), education (high school graduate/GED/Associate's or less and

college or higher), and annual household income (<\$30,000, \$30,000-\$80,000, and >\$80,000). These variables were collected at baseline and were time-fixed. Sexual behavior information was collected at every study assessment and were included as time varying variables. These variables included condomless anal sex with any partner in the past 12 months (yes/no), sex while drunk in the past 3 months (yes/no), and sex while high in the past 3 months (yes/no).

Statistical Analysis

Describing the Characteristics of the HIV-Negative Male Partners at Baseline—

To describe the HIV-negative male partners, baseline sociodemographic characteristics, sexual behaviors, their PrEP use and adherence, and their partner's ART use, self-reported ART adherence, and viral load were described using means and proportions.

Generalized Estimating Equation Model to Estimate the Odds of Current PrEP Use—

A repeated-measures analysis using a generalized estimating equation (GEE) model with a log link function was used to estimate the marginal longitudinal predictive relationship between current use of PrEP among HIV-negative partners and current use of ART among HIV-positive partners, meaning that the estimates should be interpreted on a population level. These equations accounted for within-subject correlation of repeated measures across all follow-up assessments.¹⁸

Bivariate analyses to estimate the odds of current PrEP use among HIV-negative partners were conducted with respect to the primary exposure as well as the other included independent variables. Bivariate analyses controlled for randomization arm and study assessment time point. Three multivariable models were created, with each model including one of the primary exposures. Model 1 included the variable "Partner's current ART use", Model 2 included "Partner's self-reported adherence to ART", and Model 3 included "Partner's viral load". Variables that were predictive of current PrEP use in the bivariate analyses at a $p < 0.20$ level were included in a multivariable models. Backward stepwise elimination was then conducted to achieve the most parsimonious model by comparing the GEE fit criteria's QIC scores, with lower scores indicating greater parsimony. The multivariable models were adjusted for recruitment city, randomization arm, study assessment time point, age at enrollment, race/ethnicity, annual household income, and education. All statistical analyses were conducted in SAS 9.4 (Cary, NC).

RESULTS

Characteristics of the HIV-Negative Male Partners at Baseline

The dataset of HIV-negative male partners included 120 of the 155 HIV-negative male partners who were enrolled in Project Stronger Together (Table 1). Approximately two out of every five (41.7%) HIV-negative male partners were current PrEP users. Most of the sample had HIV-positive partners who were current ART users (83.3%). Two of every five HIV-negative partners (40.8%) had HIV-positive partners who self-reported being 100% adherence to ART, and nearly two-thirds (62.5%) had HIV-positive partners with an undetectable viral load.

The mean age of the participants was 39.7 (11.7). Nearly two-thirds (65.8%) were non-Hispanic White, 20.8% were non-Hispanic Black, 11.7% were Latino/Hispanic, and 1.7% were another race. Half of the sample completed at least a four year college (50.0%), one-third (35.8%) had an annual household income of <\$30,000, one-third (31.7%) had an annual household income between \$30,000 and \$80,000, and 32.5% reported an annual household income of over \$80,000. Nearly three-quarters (72.5%) of participants reported having condomless anal sex with any partner in the past 12 months, one-third (31.7%) reported having sex while drunk in the past 3 months, and 27.5% reported having sex while high in the past three months. Participants were geographically diverse (35.8% from Atlanta, GA, 45.0% from Chicago, IL, and 19.2% from Boston, MA) and just over half of the participants were randomized into the control arm (50.8%).

We hypothesize that HIV-negative partners whose HIV-positive partner's have favorable HIV treatment outcomes have greater odds of currently using PrEP.

Generalized Estimating Equation Model to Estimate the Odds of Current PrEP Use

Results of the bivariate GEE models for current PrEP use are presented in Table 2. In the bivariate analysis, HIV-positive partner's current ART use (odds ratio [OR]=1.52, 95% confidence interval [CI]=0.76, 3.07) nor their viral load (OR=1.59, 95% CI=0.90, 2.78) was associated with the HIV-negative partner's current PrEP use. The HIV-positive partner's self-reported adherence to ART was also not associated with current PrEP use.

HIV-negative male partners who completed college had more than twice the odds (odds ratio [OR]=2.24, 95% confidence interval [CI]=1.14, 4.42) of current PrEP use compared to participants who completed high school/Associate's degree or less. Condomless anal sex in the past 12 months (OR=2.25, 95% CI=1.94, 4.24) and having had sex while drunk in the past 3 months (OR=2.08, 95% CI=1.07, 4.02) were both predictive of increased odds of current PrEP use.

Results of the multivariable models for current PrEP use are presented in Table 3. Model 1 included their HIV-positive partner's current ART use, age, race, education, annual household income, condomless anal sex in the past 12 months, recruitment city, randomization arm, and study assessment time point. HIV-negative partners whose HIV-positive partners were current ART users did not have statistically greater odds of current PrEP use (aOR=1.43, 95% CI=0.66, 3.12) compared to those whose partners were not on ART. Increasing age was predictive of lower odds of being on PrEP (aOR=0.96, 95% CI=0.93, 0.99). Those who completed at least college had nearly three times the odds of being on PrEP (aOR=2.77, 95% CI=1.16, 6.59) compared to those who completed high school/Associates or less. Lastly, those who reported engaging in condomless anal sex in the past 12 months had nearly twice the odds (aOR=1.78, 95% CI=0.92, 3.45) of being a current PrEP user compared to those who did not report condomless anal sex, though this association was not significant at a $p < 0.05$ level.

Model 2 included their HIV-positive partner's self-reported adherence to ART, age, race, education, annual household income, condomless anal sex in the past 12 months, recruitment city, randomization arm, and study assessment time point. HIV-negative partners

whose HIV-positive partner self-reported 90–99% (aOR=1.33, 95% CI=0.64, 2.77) or 100% adherence (aOR=1.44, 95% CI=0.53, 2.44) to ART did not have statistically lower odds of being a current PrEP user compared to HIV-negative partners whose partner less than 90% adherent. Increasing age was found to be predictive of lower odds of being on PrEP (aOR=0.96, 95% CI=0.93, 0.99). Those who completed at least college had nearly three times the odds of being on PrEP (aOR=2.78, 95% CI=1.17, 6.61) compared to those who completed high school/Associates or less. Lastly, those who reported engaging in condomless anal sex in the past 12 months had nearly twice the odds (aOR=1.90, 95% CI=0.94, 3.87) of being a current PrEP user compared to those who did not report condomless anal sex, though this association was not significant at a $p<0.05$ level.

Model 3 included their HIV-positive partner's viral load, age, race, education, annual household income, condomless anal sex in the past 12 months, recruitment city, randomization arm, and study assessment time point. HIV-negative male partners who had HIV-positive partners with an undetectable viral load had twice the odds of being a current PrEP user (adjusted odds ratio [aOR]=2.00, 95% CI=1.14, 3.57) compared to HIV-negative partners with HIV-positive partners with a detectable viral load. Increasing age was also found to be predictive of lower odds of being on PrEP (aOR=0.96, 95% CI=0.92, 0.99). Participants who completed college had nearly three times the odds (aOR=2.75, 95% CI=1.14, 6.66) of current PrEP use compared to participants who completed high school/Associate's degree or less. Additionally, participants recruited from Chicago, IL had much greater odds (aOR=4.53, 95% CI=1.56, 13.16) of current PrEP use compared to those recruited from Boston, MA. Those who reported engaging in condomless anal sex in the past 12 months had twice the odds (aOR=1.99, 95% CI=0.97, 4.07) of being a current PrEP user compared to those who did not report condomless anal sex, though this association was not significant at a $p<0.05$ level.

Neither race nor income were significant in any of the three models.

DISCUSSION

To the best of our knowledge, this study is the first to examine the longitudinal predictive relationship between current PrEP use by HIV-negative male partners in serodiscordant primary partnerships and their HIV-positive partner's ART use, ART adherence, and viral load. We found that HIV-negative partners who had HIV-positive partners with undetectable viral loads were significantly more likely to use PrEP compared to those with HIV-positive partners with detectable viral loads. One study of HIV-negative seroconcordant male couples found that the strongest predictor of personal PrEP use was if their partner used PrEP.¹⁹ Another study that examined the impact of primary partners on ART use and adherence found that the association between relationship dynamics and ART adherence among HIV-positive seroconcordant couples is cyclic.²⁰ Partners often encourage each other to engage in HIV care, which strengthens their relationship dynamics, which in turn provides more motivation to ensure that both partners are healthy, and so on. While these studies may not fully explain our finding, they demonstrate how partners can reinforce, or potentially weaken, each other's HIV-related health-promoting behaviors. The development of dyad-level HIV prevention interventions have become a priority in reducing the HIV transmission

rate among MSM and our finding highlights the need develop strategies to improve HIV medication use and adherence by both partners in serodiscordant relationships. It should also be noted that viral loads can fluctuate quickly and changes in viral load which crosses the 200 copies/mL threshold could be attributable to treatment failure or nonadherence to ART, among other reasons. The HIV-positive partner's self-reported ART use and adherence, however, were not predictive of current PrEP use by the HIV-negative partner. While we would expect that 100% adherence to ART would lead to viral suppression, there have been studies showing that self-reported ART adherence is often unreliable, possibly due to longer recall periods (e.g., adherence over the past week compared to adherence over the past month). Additionally, the Undetectable = Untransmittable initiative has become a vital messaging campaign to reduce HIV-related stigma,²¹ and is also very relevant to the central idea of this study. Among mutually monogamous couples, PrEP use may not indefinitely be necessary to lower the risk of HIV transmission if the HIV-positive partner is fully adherent to ART and undetectable. With that said, we do want to emphasize the important of having collective goals since dyadic benefits of mutual pill-taking do exist.

We did not find any statistical differences with respect to current PrEP use by race. A growing body of literature has documented racial disparities in PrEP use, particularly that Black MSM are less likely to use PrEP compared to white MSM.^{22,23} There are several reasons that may explain why our finding does not align with these other reports; most notably, by design, everyone in our study sample had a partner living with HIV, which was not an eligibility criterion in the prior studies. A study published in 2019 reported that MSM and transgender women who had HIV-positive primary partners had more than three times the odds of starting PrEP compared to those who did not.²⁴ The authors also reported that there were no statistically significant racial differences in PrEP use by HIV-negative MSM and transgender women when controlling for their partners' HIV status. This may suggest that our understanding of racial disparities in PrEP use may not extend to the subset of HIV-negative MSM in serodiscordant relationships. More research is needed to better understand how and why racial disparities in current PrEP use may differ depending on the characteristics of their relationship(s).

Lastly, we suspect that HIV-negative partners who self-reported having condomless anal sex with any sexual partner in the past 12 months had greater odds of PrEP use compared to those who did not. While this variable did not end up being statistically significant ($p > 0.05$), the odds ratios associated with condomless anal sex in both Model 1 and Model 2 are close to 2.0. Recent studies have found that both HIV-negative and HIV-positive MSM are more likely to forego using condoms during sex if their sexual partner reports PrEP use.^{25–27} Similarly, a systematic review and meta-analysis of papers reporting on the effects of PrEP use on sexual behaviors among MSM found evidence of an increased proportion of MSM who reported condomless sex with an HIV-positive or HIV-unknown partner after initiating PrEP.²⁸ While condomless anal sex can increase HIV risk, optimal adherence to PrEP can greatly reduce the chance of acquiring HIV. However, there is a dose-response relationship between PrEP adherence and the protective benefits of PrEP, and studies have found that MSM who were using but not adherent to PrEP were also more likely to engage in condomless anal sex compared to MSM who were not using PrEP.^{27,29} While our data confirmed our hypothesis that HIV-positive partners who had an undetectable viral load

were more likely to have HIV-negative partners who use PrEP, HIV-negative partners may also be more inclined to use PrEP if they have non-primary sexual partners, especially if their sexual partners' HIV or PrEP status is unknown. Developing effective interventions to increase PrEP adherence has been challenging. A recent pilot study tested the effect of cognitive behavioral therapy on PrEP adherence; however, among participants who completed all study visits, there were no statistically significant differences with respect to PrEP adherence between those who received cognitive behavioral therapy and those randomized into the control arm.³⁰ Interventions to improve PrEP use and adherence should emphasize the implications of suboptimal adherence, since it undermines the benefits of the medication.

There are several limitations to this study. First, participants were recruited from three major metropolitan cities in the United States where HIV-related health services are more accessible and comprehensive compared to what is available in rural areas of the country. Second, participants who volunteer to participate in randomized controlled trials may be more health conscious than those who do not. Third, all data except for biological testing data were self-reported. Additionally, not all variables included in the analysis aligned with the 6-month follow-up schedule and may be subject to recall and/or social desirability bias. We also did not have the insurance status of all participants, which may be a confounder in this analysis. We also compared the 35 HIV-positive participants who were excluded to those who were included and found that those who were excluded were less likely to have been taking ART during baseline, but there was no difference in their partners' PrEP use nor any demographic differences. This loss to follow-up may have introduced bias in our analysis. Lastly, this paper reported on the results of secondary data analyses and the study may not have been fully powered for this purpose.

Despite these limitations, our study is the first to examine the longitudinal predictive relationship between current PrEP use by HIV-negative male partners in serodiscordant primary partnerships and their HIV-positive partner's ART use, ART adherence, and viral load. Our study highlights the need develop dyad-level interventions to improve HIV medication use and adherence by both partners in serodiscordant relationships. Lastly, our findings suggest that more research is needed to better understand how and why racial disparities in PrEP use vary by characteristics relationships.

Conflicts of Interest and Source of Funding:

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Table 1.

Baseline Characteristics of HIV-Negative Male Partners Enrolled in Project Stronger Together, Atlanta, Chicago and Boston, 2015–2016 (N=120)

	Total (n=120)
Current PrEP use	
No	70 (58.3)
Yes	50 (41.7)
Partner's current ART use	
No	20 (16.7)
Yes	100 (83.3)
Partner's viral load	
Detectable	45 (37.5)
Undetectable	75 (62.5)
Partner's self-reported adherence to ART	
<90%	36 (30.0)
90–99%	35 (29.2)
100%	49 (40.8)
Age	
Mean (SD)	39.7, 11.7
Min, Max	18, 69
Race/ethnicity	
Non-Hispanic Black	25 (20.8)
Non-Hispanic White	79 (65.8)
Latino/Hispanic	14 (11.7)
Other	2 (1.7)
Education	
High school graduate/Associate's or less	60 (50.0)
College or higher	60 (50.0)
Annual household income	
<\$30,000	43 (35.8)
\$30,000-\$80,000	38 (31.7)
\$80,001+	39 (32.5)
Condomless anal sex (past 12 mo.)	
No	33 (27.5)
Yes	87 (72.5)
Had sex while drunk (past 3 mo.)	
No	82 (68.3)
Yes	38 (31.7)
Had sex while high (past 3 mo.)	
No	87 (72.5)
Yes	33 (27.5)

	Total (n=120)
Recruitment city	
Atlanta, GA	43 (35.8)
Chicago, IL	54 (45.0)
Boston, MA	23 (19.2)
Randomization Arm	
Intervention	59 (49.2)
Control	61 (50.8)

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Table 2.

Bivariate Model Results for Current PrEP use among HIV-Negative Male Partners Enrolled in Project Stronger Together Atlanta, Chicago and Boston, 2015–2016 (N=120)

	Unadjusted Bivariate Analyses		
	Unadjusted odds ratio	95% CI	P-value
Partner's current ART use			
No	-	-	-
Yes	1.52	0.76, 3.07	0.2371
Partner's viral load			
Detectable	-	-	-
Undetectable	1.59	0.90, 2.78	0.1113
Partner's self-reported adherence to ART			
<90%	-	-	-
90–99%	1.51	0.78, 2.93	0.2224
100%	1.29	0.65, 2.57	0.4676
Age	0.99	0.96, 1.02	0.3549
Race/ethnicity			
Non-Hispanic Black	0.55	0.24, 1.26	0.1557
Non-Hispanic White	-	-	-
Latino/Hispanic	0.94	0.34, 2.65	0.9111
Other	1.97	1.39, 36.81	0.0186
Education			
High school graduate/Associate's or less	-	-	-
College or higher	2.24	1.14, 4.42	0.0196
Annual household income			
<\$30,000	0.78	0.35, 1.75	0.5527
\$30,000-\$80,000	-	-	-
\$80,001+	1.57	0.68, 3.66	0.2910
Condomless anal sex (past 12 mo.)			
No	-	-	-
Yes	2.25	1.94, 4.24	0.0121
Had sex while drunk (past 3 mo.)			
No	-	-	-
Yes	2.08	1.07, 4.02	0.0297
Had sex while high (past 3 mo.)			
No	-	-	-
Yes	1.23	0.61, 2.48	0.5619
Recruitment city			
Atlanta, GA	1.16	0.43, 3.16	0.7723
Chicago, IL	2.58	0.98, 6.83	0.0562
Boston, MA	-	-	-

* Randomization arm and study assessment time point were controlled for all analyses presented in this table

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Table 3. Multivariable Model Results for Current PrEP use among HIV-Negative Male Partners Enrolled in Project Stronger Together, Atlanta, Chicago and Boston, 2015–2016 (N=120)

	Model 1. HIV-Positive Partner's Current ART Use			Model 2. HIV-Positive Partner's Self-Reported ART Adherence			Model 3. HIV-Positive Partner's Viral Load		
	Adjusted odds ratio	95% CI	P-value	Adjusted odds ratio	95% CI	P-value	Adjusted odds ratio	95% CI	P-value
Partner's current ART use	-	-	-	-	-	-	-	-	-
No	1.43	-	-	-	-	-	-	-	-
Yes	-	0.66, 3.12	0.3640	-	-	-	-	-	-
Partner's self-reported adherence to ART									
<90%									
90–99%				1.33	0.64, 2.77	0.4445			
100%				1.14	0.53, 2.44	0.7346			
Partner's viral load									
Detectable									
Undetectable							2.00	1.14, 3.57	0.0169
Age	0.96	0.93, 0.99	0.0383	0.96	0.93, 0.99	0.0337	0.96	0.92, 0.99	0.0242
Race/ethnicity									
Non-Hispanic Black	0.57	0.21, 1.50	0.2514	0.56	0.21, 1.50	0.2456	0.46	0.16, 1.31	0.1460
Non-Hispanic White	-	-	-	-	-	-	-	-	-
Latino/Hispanic	0.34	0.12, 1.02	0.0549	0.34	0.11, 1.00	0.0502	0.40	0.12, 1.32	0.1324
Other	5.35	0.41, 70.32	0.2018	4.84	0.38, 62.03	0.2254	5.53	0.59, 51.86	0.1339
Education									
High school graduate/Associate's or less	-	-	-	-	-	-	-	-	-
College or higher	2.77	1.16, 6.59	0.0215	2.78	1.17, 6.61	0.0205	2.75	1.14, 6.66	0.0248
Annual household income									
<\$30,000	0.72	0.28, 1.85	0.4958	0.69	0.27, 1.80	0.4496	0.80	0.30, 2.13	0.6544
\$30,000-\$80,000	-	-	-	-	-	-	-	-	-
\$80,001+	1.23	0.49, 3.13	0.6566	1.24	0.49, 3.11	0.6525	1.39	0.52, 3.69	0.5075
Condomless anal sex (past 12 mo.)									

	Model 1. HIV-Positive Partner's Current ART Use			Model 2. HIV-Positive Partner's Self-Reported ART Adherence			Model 3. HIV-Positive Partner's Viral Load		
	Adjusted odds ratio	95% CI	P-value	Adjusted odds ratio	95% CI	P-value	Adjusted odds ratio	95% CI	P-value
No	-	-	-	-	-	-	-	-	-
Yes	1.78	0.92, 3.45	0.0864	1.77	0.91, 3.44	0.0905	1.99	0.97, 4.07	0.0599
Recruitment city									
Atlanta, GA	1.06	0.36, 3.10	0.9184	1.04	0.36, 3.05	0.9408	1.69	0.56, 5.14	0.3530
Chicago, IL	2.80	0.96, 8.14	0.0585	2.72	0.94, 7.89	0.0654	4.53	1.56, 13.16	0.0054
Boston, MA	-	-	-	-	-	-	-	-	-

* Randomization arm and study assessment time point were controlled for all analyses presented in this table