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Sexually transmitted infections and infectiousness beliefs among people living with HIV/AIDS: implications for HIV treatment as prevention

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Abstract

Objectives—Sexually transmitted infections (STI) significantly impact the health of people living with HIV/AIDS, increasing HIV infectiousness and therefore transmissibility. The current study examined STI in a community sample of 490 HIV positive men and women.

Methods—Confidential computerized interviews were collected in a community research setting.

Results—14% of the people living with HIV/AIDS in this study had been diagnosed with a new STI in a six month period. Individuals with a new STI had significantly more sex partners in that time period, including non-HIV positive partners. Participants who had contracted an STI were significantly more likely to have detectable viral loads and were less likely to know their viral load than participants who did not contract an STI. Multivariate analysis showed that believing an undetectable viral load leads to lower infectiousness was associated with contracting a new STI.

Conclusions—Individuals who believe having an undetectable viral load reduces HIV transmission risks were more likely infectious because of STI co-infection. Programs that aim to use HIV treatment for HIV prevention must address infectiousness beliefs and aggressively control STI among people living with HIV/AIDS.

Keywords

HIV/AIDS prevention; HIV/AIDS treatment; Sexually Transmitted Infections

Introduction

HIV is most commonly spread by people who have not yet tested HIV positive and therefore do not know they are HIV infected. The majority of individuals diagnosed with HIV avoid exposing sex partners to the virus. HIV positive persons who do engage in unprotected sex with unknown status or HIV negative sex partners more often do so when they believe they are not infectious [1]. Although HIV transmission can occur at any point in the HIV disease process, infectiousness is greatest in the very earliest stages of infection, e.g. acute infection [2-4] and later again during symptomatic HIV disease [5,6]. At all stages of HIV infection, antiretroviral treatments effectively suppress HIV replication, reduce concentrations of virus, and potentially decrease infectiousness [7]. Undetectable viral load in blood plasma appears fairly stable, suggesting that infectiousness may not vary considerably between viral load tests in clinical care [8]. Consensus is building around the concept of reducing infectiousness with HIV treatments for HIV prevention [9-11]. Indeed, the Swiss Federal AIDS Commission officially stated that people living with HIV/AIDS who have effectively

suppressed HIV replication demonstrated by repeated undetectable viral load test results can be considered non-infectious, alleviating concern about HIV transmission [9-12].

Potential reductions in HIV transmission risks resulting from effective HIV treatments are unfortunately negated by several factors including antiretroviral drug penetration into the genital tract [13,14] and viral shedding caused by co-occurring sexually transmitted infections (STI) [15,16]. In addition, migration of immune cells to the site of genital tract infection can increase concentrations of HIV infected cells, potentially enhancing cell-associated viral transmission. Because blood plasma viral load remains unchanged during STI episodes, co-infection of HIV with other STI results in a person being far more infectious than they could possibly know. Studies suggest that STI prevalence is high among people living with HIV/AIDS. For example, Rieg et al. [17] reported 14% of HIV positive men who have sex with men (MSM) attending HIV clinics in Los Angeles had an asymptomatic STI. A population-based study of people living with HIV/AIDS in New York City found a 2.4% annual incidence of STI with highest incidence (8.4%) among persons aged 13-24 [18]. Dougan et al. [19] reported that 42% of MSM diagnosed with syphilis in 11 Western European countries were HIV positive and in England and Wales 32% of MSM with gonorrhea were HIV positive. High rates of STI have also been reported among people living with HIV in the Caribbean [20], Thailand [21], and southern Africa [22]. Should HIV treatments for HIV prevention prove efficacious, prevalent STI among people living with HIV/AIDS will undermine their protective benefits.

The current study investigated the behavioral characteristics of people living with HIV/AIDS who had recently been diagnosed with a new STI. We tested the association between sexual behaviors with non-HIV positive (i.e., serodiscordant) sex partners and knowledge of one's own viral load and recent STI diagnosis. In this same framework, we examined HIV infectiousness and treatment optimism beliefs that are commonly associated with increased sexual risk behaviors among people living with HIV/AIDS [21-22] in relation to knowledge of viral load and having been diagnosed with an STI.

Methods

Participants

Three hundred and twenty men, 137 women, and 33 transgender persons living with HIV/AIDS were recruited from AIDS service organizations, health care providers, social service agencies, and infectious disease clinics in Atlanta, GA. Recruitment relied on provider referrals and word-of-mouth. Specifically, we notified AIDS services providers and infectious disease clinics in Atlanta about the study opportunity. We also placed study recruitment brochures in provider's lobbies and waiting areas. We also provided participants with recruitment brochures and asked them to refer their HIV positive friends to the study. Interested persons phoned our research program to schedule an intake appointment. The study entry criteria were age 18, proof of positive HIV status using a photo ID and name matching antiretroviral (ARV) prescription bottle, HIV/AIDS clinic card, positive HIV test result, lab report, or other proof of HIV status. Data were collected between November 2005 and February 2009.

Measures

Assessments were administered using audio-computer-assisted structured interviews (ACASI). Participants viewed assessment items on a 15-inch color monitor, heard items read by machine voice using headphones, and responded by clicking a mouse. Research has shown that ACASI procedures yield reliable responses in sexual behavior interviews with higher response rates than obtained from face-to-face interviews [23]. Participants were

instructed to use the mouse prior to the assessment. Although 37% of participants had not used a computer in the previous 2 months, few difficulties were encountered by participants completing the assessments.

Demographic and health characteristics—Participants were asked their age, years of education, income, ethnicity, and employment status. We assessed HIV related symptoms using a previously developed and validated measure of 14 common symptoms of HIV disease. Participants indicated whether they had ever been diagnosed with an AIDS-defining condition and their most recent CD4 cell count and viral load.

Sexually transmitted infections—Participants reported whether they had been diagnosed with a non-HIV STI during a 6-month window. Data were collected at the initial assessment for the previous 3-months and again 3-months later. Participants who indicated that they had been diagnosed with an STI in either of the three month time blocks were defined as having a recent STI diagnosis. We asked which STI participants were diagnosed with, and the STI symptoms they experienced.

Sexual risk and protective behaviors—Participants responded to questions assessing their number of male and female sex partners and frequency of sexual behaviors in the previous 3-months. Specifically vaginal and anal intercourse with and without condoms were assessed within seroconcordant (i.e., same HIV status) and serodiscordant (i.e., HIV positive and HIV negative mixed) partnerships. A 3-month retrospective period was selected because previous research has shown reliable reports for numbers of partners and sexual events over this time period [24]. Participants were instructed to think back over the past 3-months and estimate the number of sex partners and number of sexual occasions in which they practiced each behavior. The instructions included cues for recollecting behavioral events over the past 3-months.

Infectiousness beliefs and treatment optimism—Our measure of infectiousness beliefs was adapted from previous research [25] and included four items; “People with HIV who take HIV medications are less likely to infect their sex partners during unsafe sex”, “HIV treatments make it easier to relax about unsafe sex”, “It is safe to have sex without a condom when my viral load is undetectable”, and “People with an undetectable viral load do not need to worry so much about infecting others with HIV”. We also assessed HIV treatment optimism using four items adapted from previous research. The treatment optimism beliefs include “New treatments for HIV have brought hope for a cure”; “HIV will soon be a controllable disease like diabetes”; and “There will be a cure for HIV in the next few years.” Infectiousness beliefs and treatment optimism were responded to on 6-point scales, 1= strongly disagree, 6= strongly agree. Mean scores were computed for both infectiousness beliefs ($\alpha = .77$) and treatment optimism ($\alpha = .66$).

Alcohol Use Disorders Identification Test (AUDIT)—The AUDIT consists of 10 items designed to identify risks for alcohol abuse and dependence [26]. The first three items of the AUDIT represent quantity and frequency of alcohol use and the remaining seven items concern problems incurred from drinking alcohol. AUDIT scores range from 0 – 40, with scores of ≥ 8 indicating high-risk for problem drinking.

Drug Abuse Screening Test (DAST - 10)—This scale is an abbreviated version of the original DAST, designed to identify drug-use related problems in the past year [27]. The DAST is internally consistent and has demonstrated time stability and acceptable sensitivity and specificity in detecting drug abuse. Scores range from 0 to 10.

Data analyses

We examined factors associated with having recently been diagnosed with an STI among men and women living with HIV/AIDS. Participants who had been diagnosed with an STI during the 6-month window were compared to those who did not have an STI in that time period using logistic regressions, reporting odds ratios, 95% confidence intervals, and significance.

We also tested for differences between STI groups on sexual behaviors, infectiousness beliefs and HIV treatment optimism in analyses that included current viral load as a moderating variable. Specifically, we conducted STI diagnosis (not having a recent STI / having had an STI) $\times$ viral load (detectable, undetectable, not known) analyses of variance with sexual behaviors entered as the dependant variables. These 2×3 analyses of variance yielded main effects for (a) having had a recent STI diagnosis and (b) viral load, and the interaction between recent STI diagnosis and viral load. A multivariate analysis was subsequently performed entering all factors found different between STI groups at the $p < .05$ level of significance in the univariate analyses. We used multivariate logistic regression to simultaneously enter variables in a model differentiating participants who did not have a recent STI and those who had been diagnosed with an STI. Because sexual behaviors were highly skewed, we transformed these variables using the formula $\log_{10}(X+1)$. Statistical significance was defined as $p < .05$.

Results

Among the 490 participants, 51(10%) reported having been diagnosed with an STI in the past 3-months at the initial assessment and 19 (4%) had been diagnosed in the subsequent three months, yielding a total of 70 (14%) HIV positive men and women reporting STI diagnoses in the six month window. Among the 420 participants who did not have a recent STI diagnosis, 273 (65%) had a lifetime history of non-HIV STI compared to 53 (76%) of persons with a recent STI, $X^2 [1, 490] = 3.0$, ns. Across participants, 35 (7%) reported genital ulcers and 34 (7%) reported genital discharge over the 6-months. For the 70 participants with recent STI only 19 (27%) indicated that this was their first non-HIV STI since testing HIV positive, 35 (50%) had two previous STI, and 16 (23%) stated that this was their third or fourth STI since testing HIV positive. Among participants with an STI diagnosis, 16 (24%) reported genital ulcers at the time of the assessment and 20 (34%) were having genital discharge. The most frequently diagnosed STIs were herpes simplex virus (HSV) infection ($n=26$, 39%) and syphilis ($n=25$, 36%). In addition, 9 (13%) participants reported having been diagnosed with Gonorrhea, 14 (21%) had Chlamydia, and 4 (6%) were diagnosed with non-specific urethral infection.

Demographics, health characteristics, and substance use

Comparisons of participants who had not been diagnosed with a recent STI and those who had been diagnosed on demographic and health characteristics are shown in Table 1. Three out of four participants were receiving ART and treatment was proportional among those who had not and who had been diagnosed with a recent STI. Participants who had a recent STI were significantly younger and had fewer years of education than their counterparts who had not been diagnosed with an STI. Individuals with a recent STI had experienced more HIV-related symptoms, had lower CD4 cell counts, and were significantly more likely to be unaware of their viral load and less likely to indicate having an undetectable viral load.

Individuals who were recently diagnosed with an STI also demonstrated significantly greater alcohol use, including higher rates of problem drinking on the AUDIT. Non-alcohol drug

use was far less common in the sample. However, participants who had a recent STI were more likely to have used cannabis in the previous 3-months (see Table 2).

Sexual risk and protective behaviors

Analyses examining sexual behaviors with all partners showed that participants recently diagnosed with an STI had significantly more partners, more protected intercourse, and more total intercourse than participants who had not been diagnosed with a recent STI. There were no effects of participant viral load and there were no STI $\times$ viral load interactions for sex behaviors across all partners (see Table 3).

Results for sexual behaviors with non-HIV positive partners demonstrated a different pattern. There was a main effect for viral load on protected sex and on total sex acts; participants with a detectable viral load reported significant greater rates of protected and total sex acts. There was also a main effect for having contracted an STI on number of non-HIV positive partners; participants who contracted an STI reported a greater number of partners. However, the interaction between viral load and having an STI was significant for protected and total sex acts; participants who had contracted an STI and had a detectable viral load reported the highest rates of protected and total sex acts (see Table 3).

Infectivity beliefs and treatment optimism

Results showed a main effect for having a recent STI on infectiousness beliefs; individuals who had recently been diagnosed with an STI held significantly greater beliefs that an undetectable viral load renders a person non-infectious. The main effect for viral load and the STI by viral load interactions were not significant. Analyses did not indicate any differences between groups on HIV treatment optimism (see Table 3).

Multivariate model

Results of the multiple logistic regression with all non-redundant and significant factors associated with a recent STI diagnosis are shown in Table 4. The simultaneous model indicated that fewer years of education, greater HIV symptoms, use of cannabis, and greater HIV infectiousness beliefs were associated with a recent STI diagnosis over and above the other factors included in the model.

Discussion

Fourteen percent of men and women living with HIV/AIDS were diagnosed with a new STI in a six month period. These rates of incident STI are similar to other community samples of people living with HIV/AIDS [28]. Having been diagnosed with a recent STI was proportional for men and women and was not associated with income or receiving HIV treatments. Individuals who had been diagnosed with a co-occurring STI were only slightly younger, less educated, and were using more alcohol and other drugs. Recently contracting an STI was associated with poorer health including having a lower CD4 cell count, experiencing more HIV-related symptoms, and being less likely to have an undetectable viral load. STI co-infection was also associated with being unaware of one's viral load, a potential indicator of poor engagement with health care. Together, these findings do not support the notion that improved health status accounts for increases in sexual risk behavior in people living with HIV/AIDS.

The association between believing that one is less infectious when their viral load is undetectable and being diagnosed with an STI was significant even after accounting for age, education, substance use, viral load and other health markers. These findings confirm previous research indicating that infectiousness beliefs play a central role in continued HIV

transmission risks for some people living with HIV [1]. The current study is the first we are aware of to report an association between infectiousness beliefs and STI co-infection, a circumstance that increases infectiousness regardless of blood serum viral load.

Having contracted an STI was not related to higher rates of unprotected sex. Indeed, greater rates of condom use with non-positive partners were observed among participants who had contracted an STI. This paradoxical finding is accounted for, however, by individuals who were diagnosed with an STI having a greater number of sex partners, including non-HIV positive sex partners. Partner selection strategies may therefore play an important role in contracting new STI among people with HIV. In particular, selecting same HIV status sex partners for unprotected sex (i.e., serosorting) does not protect against, and may even increase STI risks [7,29]. In addition, the greatest rates of condom use with non-HIV positive partners were observed among participants who had been diagnosed with an STI and had a detectable viral load, again suggesting that people living with HIV take their viral load into account when making sexual decisions.

The current findings should be interpreted in light of their methodological limitations. Although statistically significant, some of the associations we observed were small in magnitude, such as the differences between STI groups on age and education. We used the more reliable and valid computerized interviews to collect sexual behaviors because it is less likely to induce socially desirable responding. Still our behavioral measures were self-reported and may nevertheless have been influenced by social desirability biases. The behavioral risks that we observed should therefore be considered lower-bound estimates of HIV transmission risks among people living with HIV/AIDS. In addition, we measured STI co-infection using self-reports which are also limited by socially desirable responding. Our community sample of people living with HIV/AIDS prohibited access to multiple clinics for medical records to confirm STI diagnoses. We also did not collect biological specimens for STI confirmation because point prevalence estimates do not confirm broader intervals of diagnoses. We were also unable to detect asymptomatic STI, again suggesting a lower bound estimate of STI. Our study was conducted with a convenience sample recruited in one city in the southeastern United States, limiting the generalizability of our findings to other populations in other regions. With these limitations in mind, we believe that the current findings have important implications for HIV prevention with people living with HIV/AIDS.

Research over the past decade shows believing a person with HIV is less infectious when told they have an undetectable viral load is associated with HIV transmission risk behaviors [30]. Left unchecked, infectiousness beliefs can lead to increased risk behaviors, such as numbers of sex partners, and therefore exposure to STI, resulting in greater infectiousness than one could possibly know from their blood serum viral load. Fortunately, beliefs are amenable to interventions. Providing accurate information about the risks for STI and HIV transmission that is relevant to one's relationships and life circumstances may be sufficient for reducing HIV transmission risks among some persons living with HIV/AIDS. However, others will require interventions that go beyond viral load education, understanding infectiousness, and the limitations of partner selection strategies. Interventions aimed at limiting numbers of sex partners and reducing unprotected sex typically require building new skills for sustaining long term behavior change [31]. Interventions that include HIV status disclosure decision skills have been effective in reducing HIV risks in serodiscordant relationships and should be integrated in future interventions [32,33]. Perhaps most essential to HIV prevention with people who have HIV/AIDS is the integration of STI diagnostic and treatment into routine clinical services. Patients should also be taught how to recognize early symptoms of STI and told they should seek health services if they suspect STI symptoms. Early detection and aggressive treatment of STI co-infections are necessary for reducing genital fluid infectiousness. Scaling up antiretroviral therapy for HIV prevention will

therefore only be successful when infectiousness beliefs are reality-based and when co-occurring STI are prevented, rapidly detected and treated.

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Demographic and health characteristics of people living with HIV/AIDS who had not been and who had been diagnosed with a recent STI.

Table 1

	Not Diagnosed with recent STI (N = 420)			Diagnosed with recent STI (N = 70)		
	M	SD	N	M	SD	OR 95%CI
Age	44.6	7.0		42.3	7.3	0.9*
Years of education	12.6	2.2		11.7	1.8	0.8**
HIV symptoms	2.9	2.8		4.9	3.3	1.2**
Most recent CD4 count	434.1	292.1		337.6	310.9	0.9**
	N	%	N	%		
Men	305	73	48	69		
Women	115	27	22	31		1.2 0.7-2.1
Transgender	26	6	7	10		0.6 0.3-1.4
African American	379	90	63	90		
Other races	41	10	7	10		0.6 0.3-1.3
Income < \$10,000	285	68	52	75		0.9 0.6-1.3
Unemployed	148	35	27	39		1.1 0.6-1.7
Receiving ART	306	76	46	66		0.7 0.4-1.2
	N	%	N	%		
Viral load undetectable	195	47	22	32		
Viral load detectable	150	36	23	33		
Viral load unknown	72	17	24	35		1.5* 1.1-2.1
Hospitalized for HIV						
Never	204	49	31	44		
1	61	15	5	7		
2+	155	36	34	49		1.2 0.7-1.9

Note:

* p < .05,

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Table 2

Substance use among people living with HIV/AIDS who had not been and who had been diagnosed with a recent STI.

	Not Diagnosed with recent STI (N = 420)		Diagnosed with recent STI (N = 70)		t
	M	SD	M	SD	
AUDIT score	2.5	4.6	4.1	5.9	2.6**
Audit score among drinkers	4.7	5.2	7.2	6.4	2.5**
DAST Score	1.3	1.5	1.7	1.7	1.9
	N	%	N	%	X ²
Currently drink alcohol	214	51	37	53	0.1
Frequency of current alcohol use					
Never	205	49	33	47	
Monthly	115	27	19	27	
2-4 times per month	57	14	11	16	
2-3 times per week	33	8	6	9	
4 or more times per week	9	2	1	1	0.4
Possible problem drinker on AUDIT	36	9	16	23	12.8**
Cannabis use	15	4	8	11	8.2**
Cocaine use	17	4	2	4	0.9
Other drugs	2	1	1	1	n/a

Note:

* p < .05,

** p < .01

Table 3

Sex behaviors, HIV treatment optimism, and infectiousness beliefs among participants who had not been and who had been diagnosed with a recent STI and their viral load.

	Not diagnosed with recent STI						Diagnosed with recent STI												
	Knowledge of most recent Viral Load						Knowledge of most recent Viral Load												
	Detectable			Don't Know			Detectable			Undetectable			Don't Know						
	M	SD	F	M	SD	F	M	SD	F	M	SD	F	M	SD	F				
<u>All partners</u>																			
Number of partners	1.6	2.8		1.2	1.8		1.3	1.8		2.6	2.9		2.2	4.4		1.8	2.1		7.5 ^{b**}
Unprotected intercourse	2.5	9.2		1.8	6.4		1.6	4.6		1.5	3.8		1.0	2.2		3.6	7.7		ns
Protected intercourse	2.8	8.6		4.1	15.3		3.1	11.0		9.2	18.7		3.5	5.0		3.7	8.3		9.2 ^{b**}
Total intercourse	5.4	16.1		5.9	16.5		4.7	12.1		10.7	20.3		4.6	6.7		7.4	15.6		4.5 ^{b*}
<u>Non-HIV positive partners</u>																			
Number of partners	0.5	1.4		0.5	1.0		0.6	1.3		1.6	2.6		0.6	1.5		0.7	1.4		3.7 ^{b*}
Unprotected intercourse	0.3	1.8		1.0	5.6		0.6	2.5		0.8	2.1		0.1	0.5		0.5	1.5		ns
Protected intercourse	0.8	2.5		2.1	9.9		1.8	10.7		6.9	18.3		0.7	1.9		0.4	1.1		5.1 ^{d**}
Total intercourse	1.1	3.2		3.1	11.4		2.5	11.3		7.7	19.6		0.9	2.2		0.9	2.6		6.3 ^{c**}
Treatment optimism	3.4	1.0		3.5	1.1		3.3	1.2		3.5	1.1		3.6	1.3		3.3	1.3		3.1 ^{d*}
Infectivity beliefs	0.6	1.0		0.8	1.0		0.9	1.1		0.9	1.6		1.2	1.4		1.4	1.3		7.4 ^{b**}

Note:

^a main effect for viral load, F (2,480);^b main effect for STI, $F(1,480)$;

c viral load x STI interaction, F (2,480);

*
p < .05;

**
p < .01

Table 4

Multivariate logistic regression predicting having a new STI diagnosis among HIV positive men and women.

Variable	Adjusted OR	95%CI
Age	0.97	0.93-1.00
Education	0.85 [*]	0.73-0.98
HIV symptoms	1.17 ^{**}	1.07-1.29
CD4 cell count	1.0	0.99-1.00
Viral load	1.22	0.83-1.81
Alcohol problems-AUDIT	1.02	0.97-1.08
Used cannabis	3.57 [*]	1.21-10.55
Infectiousness beliefs	1.32 ^{**}	1.05-1.66

Note

*
p < .05,

**
p < .01