



DIGITAL ACCESS TO SCHOLARSHIP AT HARVARD

Sexual Relationship Power and Depression among HIV-Infected Women in Rural Uganda

The Harvard community has made this article openly available.
[Please share](#) how this access benefits you. Your story matters.

Citation	Hatcher, Abigail M., Alexander Chung-Yu Tsai, Elias Kumbakumba, Shari L. Dworkin, Peter W. Hunt, Jeffrey N. Martin, Gina Clark, David Roy Bangsberg, and Sheri D. Weiser. 2012. Sexual relationship power and depression among HIV-infected women in rural Uganda. PLoS ONE 7(12): e49821.
Published Version	doi:10.1371/journal.pone.0049821
Accessed	February 19, 2015 11:57:42 AM EST
Citable Link	http://nrs.harvard.edu/urn-3:HUL.InstRepos:11181028
Terms of Use	This article was downloaded from Harvard University's DASH repository, and is made available under the terms and conditions applicable to Other Posted Material, as set forth at http://nrs.harvard.edu/urn-3:HUL.InstRepos:dash.current.terms-of-use#LAA

(Article begins on next page)

Sexual Relationship Power and Depression among HIV-Infected Women in Rural Uganda

Abigail M. Hatcher^{1,2*}, Alexander C. Tsai^{3,4,5}, Elias Kumbakumba⁶, Shari L. Dworkin⁷, Peter W. Hunt¹, Jeffrey N. Martin⁸, Gina Clark⁹, David R. Bangsberg^{3,5,6}, Sheri D. Weiser¹

1 Division of HIV/AIDS, Department of Medicine, University of California San Francisco, San Francisco, California, United States of America, **2** Wits Reproductive Health & HIV Institute, University of the Witwatersrand, Johannesburg, South Africa, **3** Center for Global Health, Massachusetts General Hospital, Boston, Massachusetts, United States of America, **4** Department of Psychiatry, Massachusetts General Hospital, Boston, Massachusetts, United States of America, **5** Department of Medicine, Harvard Medical School, Boston, Massachusetts, United States of America, **6** Mbarara University of Science & Technology, Mbarara, Uganda, **7** Department of Social & Behavioral Sciences, University of California San Francisco, San Francisco, California, United States of America, **8** Department of Epidemiology, University of California San Francisco, San Francisco, California, United States of America, **9** Department of Psychiatry, University of California San Francisco, San Francisco, California, United States

Abstract

Background: Depression is associated with increased HIV transmission risk, increased morbidity, and higher risk of HIV-related death among HIV-infected women. Low sexual relationship power also contributes to HIV risk, but there is limited understanding of how it relates to mental health among HIV-infected women.

Methods: Participants were 270 HIV-infected women from the Uganda AIDS Rural Treatment Outcomes study, a prospective cohort of individuals initiating antiretroviral therapy (ART) in Mbarara, Uganda. Our primary predictor was baseline sexual relationship power as measured by the Sexual Relationship Power Scale (SRPS). The primary outcome was depression severity, measured with the Hopkins Symptom Checklist (HSCL), and a secondary outcome was a functional scale for mental health status (MHS). Adjusted models controlled for socio-demographic factors, CD4 count, alcohol and tobacco use, baseline WHO stage 4 disease, social support, and duration of ART.

Results: The mean HSCL score was 1.34 and 23.7% of participants had HSCL scores consistent with probable depression (HSCL > 1.75). Compared to participants with low SRPS scores, individuals with both moderate (coefficient $b = -0.21$; 95%CI, -0.36 to -0.07) and high power ($b = -0.21$; 95%CI, -0.36 to -0.06) reported decreased depressive symptomology. High SRPS scores halved the likelihood of women meeting criteria for probable depression (adjusted odds ratio = 0.44; 95%CI, 0.20 to 0.93). In lagged models, low SRPS predicted subsequent depression severity, but depression did not predict subsequent changes in SRPS. Results were similar for MHS, with lagged models showing SRPS predicts subsequent mental health, but not visa versa. Both Decision-Making Dominance and Relationship Control subscales of SRPS were associated with depression symptom severity.

Conclusions: HIV-infected women with high sexual relationship power had lower depression and higher mental health status than women with low power. Interventions to improve equity in decision-making and control within dyadic partnerships are critical to prevent HIV transmission and to optimize mental health of HIV-infected women.

Citation: Hatcher AM, Tsai AC, Kumbakumba E, Dworkin SL, Hunt PW, et al. (2012) Sexual Relationship Power and Depression among HIV-Infected Women in Rural Uganda. PLoS ONE 7(12): e49821. doi:10.1371/journal.pone.0049821

Editor: Paula Braitstein, Indiana University and Moi University, United States of America

Received: June 19, 2012; **Accepted:** October 17, 2012; **Published:** December 26, 2012

Copyright: © 2012 Hatcher et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Funding: The study was funded by NIH K23 MH-079713, MH-79713-03S1, NIH R01 MH-54907, NIH P30 AI27763, and the Tim and Jane Meyer Family Foundation. The authors acknowledge the following additional sources of salary support: the Burke Family Foundation, NIH K24 MH-87227, K23 MH-096620, and the Paiko Foundation. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing Interests: The authors have declared that no competing interests exist.

* E-mail: hatchera@globalhealth.ucsf.edu

Introduction

Depression is prevalent among HIV-infected populations throughout the world [1–5]. Among HIV-infected individuals in Uganda, 47% screened positive for probable depression [1], far exceeding population-based estimates of depression in the general population [2–5]. Multiple factors may contribute to high levels of depression among HIV-infected individuals, including concerns related to HIV-status disclosure [6], perceived HIV-related stigma [7–9], lack of social support [10], and the discomfort and fatigue of illness and physical decline [11–13]. Among HIV-infected persons,

symptoms of depression are associated with reduced quality of life [14,15], lower uptake of and adherence to antiretroviral treatment [16,17], immunologic decline [1,18–20], and AIDS-related mortality [12,20–23].

Depression is also particularly common among HIV-infected women, both in Uganda [10] and elsewhere globally [8,9,11,24–26]. Depression is associated with increased transmission risk behaviors among women in the general population, as well as elevated secondary transmission risk among HIV-infected women [2,27,28]. Similar to gendered risk of acquiring HIV, risk of depression once living with HIV/AIDS may be partially

attributable to gender inequalities in relationship power. This hypothesis is supported by several lines of evidence. First, low sexual relationship power is associated with experiences of intimate partner violence [29] which is itself a robust predictor of depression among women [30]. Second, analyses of data collected from samples of non-HIV-infected persons have linked powerlessness to depression among women experiencing intimate partner violence [27,31], and among young women [27,29]. Studies have found other negative health impacts of low sexual power among HIV-infected women, including malnutrition and worse HIV treatment outcomes [32,33].

While the presence or absence of intimate partner relationships [34,35] and other social ties [36] are well recognized as key contributors to mental health, less research has explored how power dynamics of intimate partnerships influence mental health [37,38]. Notably, little work has focused on elucidating how sexual relationship power influences mental health, particularly among HIV-infected women, one of the most vulnerable subgroups in resource-limited settings [39]. We therefore undertook a study to examine whether sexual relationship power is associated with symptoms of depression and mental health status among HIV-infected women in rural Uganda. We also assessed the extent to which the relationship control or decision-making dominance, subscales of the SPRS, were associated with depression.

Methods

Participants

The study took place in Uganda within the rural Mbarara District (population 427,000). The town of Mbarara (population 82,000) is located 275 kilometers southwest of Kampala. The main local language is Runyankole, and the majority of residents are ethnically Ankole. The Uganda AIDS Rural Treatment Outcomes (UARTO) prospective cohort study was initiated in July 2005. Participants were recruited from the Mbarara Regional Referral Hospital Immune Suppression Syndrome (ISS) Clinic, which dispenses free HIV antiretroviral therapy (ART) to HIV-infected persons in southwestern Uganda [40]. Participants were included if they were ART-naïve, older than 18 years of age, lived within 20 km of the ISS Clinic, and were initiating free ART. Beginning in August 2007, the study questionnaire was expanded with the addition of measures of sexual relationship power. Data for this paper were drawn from the first two quarterly study visits of all female participants who consented to the UARTO parent study.

Data collection

Study interviews were conducted using standardized interviewer-administered instruments and blood draws to collect data on sexual relationship power, health behaviors, mental health and other socio-demographic and clinical variables. Surveys and written consent forms were translated into the native language of Runyankole, back translated into English, and pilot-tested to ensure accuracy. All instruments were administered in the field by a native Runyankole speaker. We used standard procedures for data entry and quality control.

Ethics Statement

Written consent was obtained from all study participants. For participants who could not read or write, they were allowed to mark consent forms with an "X". Ethical approval for all study procedures was obtained from the University of California San Francisco Committee on Human Research, the Partners Human

Research Committee, and the Institutional Review Committee at Mbarara University of Science and Technology.

Measurements

Our primary predictor, sexual relationship power, was measured at baseline using the sexual relationship power scale (SPRS) [41], a 22-item scale that has been previously used in research conducted in black African populations [42,43]. The SPRS was developed based on Connell's Theory of Gender and Power [44], which posits that gender imbalances within the household are partly responsible for men's disproportionate power over decision-making. The SPRS contains two subscales: Relationship Control and Decision-Making Dominance. The Relationship Control subscale is comprised of fourteen questions rated on a 4-point Likert-type scale designed to assess the extent to which women can exert sexual and emotional autonomy (e.g., "If I asked my partner to use a condom, he would get angry."). The Decision-Making Dominance subscale is comprised of eight questions designed to assess the balance of decision making power within the relationship (e.g., "Who usually has more say on whether you have sex?"). Responses are summed and normalized to a range of 1 to 4, with higher scores indicating greater relationship power. As suggested by Pulerwitz et al. [41], scale scores were split into tertiles representing 'low', 'medium' and 'high' power. Both subscales had excellent internal reliability (Relationship Control Cronbach's alpha = 0.95, Decision-Making Dominance alpha = 0.92), as did the SPRS scale as a whole (Cronbach's alpha = 0.96).

Our primary outcome was depression symptom severity, measured as a continuous variable in primary analyses using a modified version of the Hopkins Symptom Checklist for Depression (HSCL-D) [45–47]. For this analysis, we used HSCL-D measurements from two time points: at baseline (*t*) and 3 months after baseline (*t*+1). This fifteen-item measure has been widely used and validated in East African settings [10,48], and achieved a high degree of internal consistency in our sample (Cronbach's alpha = 0.86). Our secondary outcome was a measure of mental well being among HIV-infected persons, namely the Mental Health Summary (MHS) of the 35-item Medical Outcomes Study HIV Health Survey (MOS-HIV) [49–52]. The MHS is derived from multiple domains of functioning, including mental health, health distress, quality of life, cognitive function, vitality, and social function. Validation studies have been conducted in numerous settings [49–52], including East Africa [53].

Statistical Analysis

We used multivariable linear regression to measure the associations between sexual relationship power and both (a) depression symptom severity (HSCL) and (b) mental health status (MHS). Depression was specified as a continuous variable, and estimates were adjusted for potential confounders, including age, CD4+ T-lymphocyte cell count, educational level, marital status, positive screen for hazardous drinking as measured by the AUDIT-C [54,55], tobacco use, history of a WHO stage 4 clinical condition, and length of time on ART. For ease of exposition we used logistic regression to estimate the association between probable depression (using the conventional threshold of 1.75 [56]) and sexual relationship power, while adjusting for the same covariates as specified above. To determine whether different aspects of relationship power were differentially associated with the outcomes of interest, we repeated the analyses using the relationship control and decision-making dominance sub-scales as covariates.

To assess the extent to which our estimates could be driven by reverse causality, we lagged covariates by three months. For this,

we used data from two time points. In the first lagged model, we estimated the association between SRPS at time t and depression at time $t+1$. In the second lagged model, we estimated the association between depression at time t and SRPS at time $t+1$. We repeated these analyses to assess directionality between SRPS and MHS.

Results

Among the 325 eligible women, only the 270 participants (83.0%) who had complete information on all variables were included in this analysis (Table 1). There was no more than 6% missing data on any specific variable, with percent missingness less than 2% for most variables. There were no statistically significant differences between the 45 excluded individuals and the 270 included individuals in terms of any of our key predictors and outcomes of interest. The median age was 34 years (interquartile range [IQR] = 28–38 years). Approximately one-third of women were married at baseline, less than one-quarter had secondary education, and 34.8% of women were unemployed. Women lived a median of 45 minutes travel from the clinic, with some participants reporting travel times of up to 7 hours. Sixty-four (23.7%) women reported symptoms consistent with probable depression. The median MHS score was 46.7 (IQR, 38.5 to 53.3).

Sexual relationship power was associated with depression symptom severity in both unadjusted and adjusted models (Table 2). Specifically, in the models with contemporaneous covariates and outcomes, women with either moderate ($b = -0.21$; 95% confidence interval [CI], -0.36 to -0.07) or high relationship power ($b = -0.21$; 95% CI, -0.36 to -0.06) had lower depression symptom severity compared to women with low

relationship power. Other correlates of depression in adjusted analyses included being ART naive at baseline and travelling a greater distance to the clinic. When the outcome was specified as a binary variable indicating probable depression, women with moderate (adjusted odds ratio [AOR] = 0.46; 95% CI, 0.22–0.97) and high (AOR = 0.44; 95% CI, 0.20–0.93) relationship power were less likely to meet screening criteria for probable depression compared to women with low SRPS scores. In the lagged-covariate specification, SRPS at time t was associated with depression at time $t+1$.

Both moderate and high sexual relationship power were also associated with MHS (Table 3). In the models with contemporaneous covariates and outcomes, women with moderate relationship power had better mental health status ($b = 3.38$; 95% CI, 0.08 to 6.68) compared to women with low relationship power. Women with high relationship power also had better mental health status ($b = 3.03$; 95%, -0.32 to 6.39), but the association was not statistically significant. Similar to the analysis of depression above, in the lagged-covariate specification, SRPS at time t was associated with MHS at time $t+1$.

Both subscales of the SRPS were associated with depressive symptoms. Women with both moderate ($b = -0.31$; 95% CI, -0.45 to -0.17) and high Relationship Control ($b = -0.19$; 95% CI, -0.33 to -0.05) had lower depression symptom severity compared to women with low relationship control. Similarly, women with moderate Decision-Making Dominance had lower depression symptom severity ($b = -0.17$; 95% CI, -0.31 to -0.03). High decision-making dominance approached, but did not reach, statistical significance ($p = 0.09$).

Finally, in order to assess the potential bi-directionality of the relationship between SRPS and the outcomes, we fit regression models with the outcomes specified as the primary exposure, and these were also lagged. Depression at time t was not predictive of SRPS at time $t+1$ (Table 4). Similarly, MHS at time t was not predictive of SRPS at time $t+1$.

Discussion

We found high levels of depression among rural Ugandan HIV-infected women, with more than one-quarter of participants meeting clinical criteria for probable depression, consistent with previous literature from the region [3,4]. The prevalence of depression in our sample (23.7%) was lower than in another Ugandan study (47%) in which participants were ART-naïve [1], consistent with considerable evidence that HAART may have psychological benefits for patients [57–59]. Women with higher sexual relationship power had reduced depression symptom severity, were less likely to meet criteria for probable depression, and had better mental health status compared to women with low relationship power. These associations were statistically significant and large in magnitude.

Our confidence in the directionality of the interpretation was strengthened by the lagged and reverse-lagged analyses, in which we showed that SRPS at time t was predictive of depressive symptoms (HSCL) at time $t+1$ but that depression at time t was not predictive of SRPS at time $t+1$. The secondary outcome of MHS exhibited similar patterns in lagged and reverse-lagged models. These data suggest that sexual relationship power may be predictive of subsequent mental health among HIV-infected women.

Our findings are consistent with the Theory of Learned Helplessness [60], which posits that self-esteem, cognition, and motivation are shaped by beliefs of personal control and perceived power over life's outcomes [61,62]. Learned helplessness, in turn,

Table 1. Descriptive Statistics.

All participants (N = 270)	
Characteristics	Median (IQR)
Sexual Relationship Power Scale (SRPS)	2.46 (2.10 to 2.85)
Sociodemographic Characteristics	
Age	34 (28 to 38)
Married	104 (38.5%)
Household size	3 (1 to 5)
Secondary education	62 (23.0%)
Unemployed	94 (34.8%)
Asset Index	-0.17 (-1.40 to 1.44)
Distance to Clinic	0.75 (0.5 to 1)
Clinical Characteristics	
HSCL	1.34 (1.12 to 1.75)
Probable depression (HSCL > 1.75)	64 (23.7%)
Mental Health Status	46.7 (38.5 to 53.3)
ART naive at baseline	178 (54.8)
Heavy drinking (AUDIT-C)	18 (6.7%)
Tobacco Use (ever)	36 (13.3%)
WHO clinical stage IV at baseline	82 (30.4%)
Previously on ART	121 (44.8%)
CD4 count at baseline	207 (136 to 308)

IQR: Inter quartile range, HSCL: Hopkins Symptomatic Check List, ART: Antiretroviral Treatment; AUDIT-C: Alcohol Use Disorders Identification Test. doi:10.1371/journal.pone.0049821.t001

Table 2. Unadjusted and adjusted associations between depression severity and sexual relationship power (N = 273).

Characteristic	Depression severity (HSCL as continuous scale) Regression estimate <i>b</i> (95% confidence interval [CI])		
	Univariable	Multivariable (Contemporaneous)	Multivariable (Lagged)
Sexual Relationship Power Scale (SRPS)			
Low	Ref	Ref	Ref
Moderate	-0.32 (-0.47 to -0.17)***	-0.21 (-0.36 to -0.07)**	-0.12 (-0.22 to -0.01)*
High	-0.29 (-0.44 to -0.14)***	-0.21 (-0.36 to -0.06)**	-0.10 (-0.20 to 0.01)
Socio-demographic Characteristics			
Age	-0.01 (-0.05 to 0.03)	0.02 (-0.02 to 0.06)	0.02 (-0.01 to 0.05)
Married	-0.03 (-0.16 to 0.10)	0.04 (-0.08 to 0.17)	0.09 (0.00 to 0.18)
Household size	0.00 (-0.03 to 0.02)	-0.01 (-0.03 to 0.01)	-0.00 (-0.02 to 0.01)
Educated more than secondary school	-0.10 (-0.25 to 0.05)	-0.05 (-0.19 to 0.09)	-0.07 (-0.17 to 0.03)
Unemployed	-0.02 (-0.15 to 0.12)	-0.05 (-0.18 to 0.07)	-0.03 (-0.12 to 0.06)
Distance to Clinic	0.08 (0.01 to 0.15)*	0.09 (0.02 to 0.15)*	0.03 (-0.02 to 0.08)
Clinical Characteristics			
Heavy drinking (AUDIT-C)	0.30 (0.05 to 0.55)*	0.13 (-0.11 to 0.38)	0.16 (-0.02 to 0.34)
Tobacco Use	0.08 (-0.10 to 0.27)	0.02 (-0.16 to 0.19)	-0.04 (-0.16 to 0.09)
WHO Stage IV clinical condition	0.02 (-0.12 to 0.15)	0.05 (-0.07 to 0.18)	0.03 (-0.06 to 0.12)
CD4 count	-0.03 (-0.08 to 0.01)	0.02 (-0.02 to 0.07)	0.04 (0.01 to 0.07)*
Previously treated with ART	-0.39 (-0.51 to -0.27)***	-0.37 (-0.51 to -0.24)***	-0.19 (-0.29 to -0.09)***
Constant	-	1.66	1.2

*P<0.05;

**P<0.01;

***p<0.001.

HSCL: Hopkins Symptomatic Check List; AUDIT-C: Alcohol Use Disorders Identification Test; WHO: World Health Organization; ART: Antiretroviral Treatment.

doi:10.1371/journal.pone.0049821.t002

has long been associated with depression in clinical populations [63–65], and recent studies in animal models have begun to establish its pathophysiology [66–70]. Likewise, the Theory of Gender and Power [44], which postulates that unequal power dynamics (in economic, decision-making, and emotional realms) limit the ability of women to exercise personal control in relationships [71], provides a strong theoretical underpinning to the associations we observed in our data. This theory has been applied to a range of health outcomes, including HIV risk [42,72–75], and intimate partner violence [29], but has yet to be explored among HIV-infected women, and has rarely been applied to mental health [76,77]. This research suggests an important area for future research and intervention development among HIV-infected, female populations.

We attempted to determine whether different aspects of relationship power were differentially associated with depression but found that both SRPS subscales had statistically significant associations with the outcomes. Previous findings regarding SRPS subscales have been mixed, with many authors omitting Decision-Making Dominance due to low reliability, and others finding that only the Relationship Control sub-scale influenced health outcomes [42,78,79]. In-depth, qualitative research could further delineate the mechanisms through which sexual power may affect mental health.

Our study had several limitations. First, our measure of depression is based on a screening tool, and does not provide a conclusive diagnosis of major depressive disorder. Second, prospective longitudinal studies using longer follow-up times (beyond 3 months) and repeated measures are needed to confirm our findings. Third, our sample was limited to women who were initiating ART. Because individuals who are receiving ART have

already overcome significant barriers to engagement in care, our findings may not be generalizable to untreated populations.

Despite these limitations, our findings have implications for designing effective interventions for the mental health of HIV-positive women. The high burden of disease and dearth of evidence-based mental health interventions in low-resource settings [80] make intervention development a priority [81–83]. While HIV-infected women are at higher risk of depression than their male counterparts [27,84], according to a recent systematic review on this topic, few specific interventions have been developed for this population [85]. Our findings suggest that relationship power may be an important potential driver of depressive symptom severity among women living with HIV and AIDS, one of the most vulnerable and marginalized subgroups in low-resource settings [39]. Effective interventions to improve women's relationship power may have the added benefit of contributing to secondary prevention of HIV transmission, since low relationship power and gender-unequal norms have been linked to higher-risk sex [86,87], inconsistent condom use [88–90], and multiple partnerships [78]. Interventions to empower women in intimate dyadic relationships may have mental health benefits and should be assessed using randomized study designs.

In conclusion, we found that sexual relationship power in a sample of women living with HIV in rural Uganda is strongly associated with symptoms of depression and worse mental health status. The overlapping epidemics of HIV/AIDS and depression require integrated programs that target the intimate relationships shaping women's overall health and well being.

Table 3. Unadjusted and adjusted associations between mental health and sexual relationship power (N = 273).

Characteristic	Mental Health Status (MHS as continuous scale) Regression estimate <i>b</i> (95% confidence interval [CI])		
	Univariable	Multivariable (Contemporaneous)	Multivariable (Lagged)
Sexual Relationship Power Scale (SRPS)			
Low	Ref	Ref	Ref
Moderate	6.40 (2.91 to 9.90)***	3.38 (0.08 to 6.68)*	3.47 (0.72 to 6.23)*
High	5.55 (2.03 to 9.06)**	3.13 (−0.21 to 6.46)	2.81 (0.13 to 5.49)*
Socio-demographic Characteristics			
Age	0.81 (−0.10 to 1.73)	−0.03 (−0.91 to 0.85)	−0.50 (−1.23 to 0.24)
Married	−2.00 (−5.02 to 1.01)	−3.23 (−6.10 to −0.36)*	−1.72 (−4.07 to 0.63)
Household size	0.03 (−0.53 to 0.58)	0.10 (−0.42 to 0.62)	0.25 (−0.19 to 0.67)
Educated more than secondary school	0.78 (−2.72 to 4.28)	0.27 (−3.41 to 2.86)	−0.50 (−3.07 to 2.06)
Unemployed	−1.92 (−5.01 to 1.16)	−0.30 (−3.13 to 2.54)	1.14 (−1.21 to 3.49)
Distance to Clinic	−1.37 (−3.05 to −0.30)	−1.85 (−3.35 to −0.35)*	−0.75 (−1.96 to 0.46)
Clinical Characteristics			
Heavy drinking (AUDIT-C)	−48.55 (−14.33 to −2.69)**	−4.15 (−9.57 to 1.26)	−3.82 (−8.25 to 0.61)
Tobacco Use	−0.66 (−4.99 to 3.67)	0.07 (−3.87 to 4.01)	1.60 (−1.67 to 4.86)
WHO Stage IV clinical condition	−0.48 (−3.68 to 2.72)	−1.85 (−4.73 to 1.02)	0.19 (−2.14 to 2.51)
CD4 count	1.69 (0.72 to 2.65)**	0.00 (−0.01 to 0.01)	0.00 (−0.01 to 0.01)
Previously treated with ART	11.25 (8.61 to 13.89)***	10.02 (7.02 to 13.02)***	3.44 (1.00 to 5.89)**
Constant	−	41.12	48.87

p*<0.05;*p*<0.01;****p*<0.001.

MHS: Mental Health Status; AUDIT-C: Alcohol Use Disorders Identification Test; WHO: World Health Organization; ART: Antiretroviral Treatment.

doi:10.1371/journal.pone.0049821.t003

Table 4. Adjusted reverse-lagged associations between SRPS and subsequent mental health.

Characteristic	Depression severity (HSCL as continuous scale)	Mental Health Status (MHS as continuous scale)
	Regression estimate <i>b</i> (95% confidence interval [CI])	
Sexual Relationship Power Scale (SRPS)	−0.11 (−0.27 to 0.04)	0.00 (−0.00 to 0.01)
Socio-demographic Characteristics		
Age	−0.01 (−0.05 to −0.07)	0.01 (−0.06 to 0.07)
Married	0.22 (0.06 to .038)**	0.23 (0.07 to 0.39)**
Household size	0.01 (−0.02 to 0.04)	0.01 (−0.02 to 0.04)
Educated more than secondary school	0.11 (−0.06 to 0.28)	0.12 (−0.06 to 0.29)
Unemployed	−0.14 (−0.31 to 0.02)	−0.14 (−0.30 to 0.02)
Distance to Clinic	0.07 (−0.02 to 0.17)	0.07 (−0.03 to 0.17)
Clinical Characteristics		
Heavy drinking (AUDIT-C)	0.18 (−0.14 to 0.50)	0.19 (−0.13 to 0.52)
Tobacco Use	0.20 (−0.05 to 0.44)	0.20 (−0.05 to 0.44)
WHO Stage IV clinical condition	−0.08 (−0.25 to 0.09)	−0.08 (−0.25 to 0.08)
CD4 count	−0.01 (−0.07 to 0.04)	−0.02 (−0.08 to 0.39)
Previously treated with ART	0.05 (−0.13 to 0.23)	−0.07 (−0.12 to .025)
Constant	2.47	2.18

p*<0.05,*p*<0.01,****p*<0.001.

HSCL: Hopkins Symptomatic Check List; MHS: Mental Health Status; AUDIT-C: Alcohol Use Disorders Identification Test; WHO: World Health Organization; ART: Antiretroviral Treatment.

doi:10.1371/journal.pone.0049821.t004

Acknowledgments

We thank the UARTO participants who gave their time to this research; Annet Kembabazi and Annet Kawuma for providing study coordination and support; Doreen Akello, Marcy Mutumba, Christine Ngabirano, Ruth Ssentongo, and Florence Turyashemererwa for research assistance; and Dr. Jessica Haberer, Dr. Nozmu Mukiiibi, Dr. Conrad Muzoora, Dr. Jude Senkungu for invaluable advice and oversight of study design and implementation. While these individuals are acknowledged for their

assistance, no endorsement of manuscript contents or conclusions should be inferred.

Author Contributions

Conceived and designed the experiments: ACT EK PWH JNM DRB SDW. Performed the experiments: ACT EK PWH JNM DRB SDW. Analyzed the data: AMH ACT SLD PWH GC SDW. Wrote the paper: AMH ACT EK SLD PWH JNM GC DRB SDW.

References

- Kaharuza FM, Bunnell R, Moss S, Purcell DW, Bikaako-Kajura W, et al. (2006) Depression and CD4 cell count among persons with HIV infection in Uganda. *AIDS Behav* 10: S105–111.
- Lundberg P, Rukundo G, Ashaba S, Thorson A, Allebeck P, et al. (2011) Poor mental health and sexual risk behaviours in Uganda: A cross-sectional population-based study. *BMC Public Health* 11: 125.
- Ovuga E, Boardman J, Wasserman D (2005) The prevalence of depression in two districts of Uganda. *Soc Psychiatry Psychiatr Epidemiol* 40: 439–445.
- Kinyanda E, Woodburn P, Tugumisirize J, Kagugube J, Ndyabangi S, et al. (2011) Poverty, life events and the risk for depression in Uganda. *Soc Psychiatry Psychiatr Epidemiol* 46: 35–44.
- Bolton P, Wilk CM, Ndongoni L (2004) Assessment of depression prevalence in rural Uganda using symptom and function criteria. *Soc Psychiatry Psychiatr Epidemiol* 39: 442–447.
- Gielen AC, McDonnell KA, Burke JG, O'Campo P (2000) Women's lives after an HIV-positive diagnosis: disclosure and violence. *Matern Child Health J* 4: 111–120.
- Prachakul W, Grant JS, Keltner NL (2007) Relationships among functional social support, HIV-related stigma, social problem solving, and depressive symptoms in people living with HIV: a pilot study. *J Assoc Nurses AIDS Care* 18: 67–76.
- Wu DY, Munoz M, Espiritu B, Zeladita J, Sanchez E, et al. (2008) Burden of depression among impoverished HIV-positive women in Peru. *J Acquir Immune Defic Syndr* 48: 500–504.
- Simbayi LC, Kalichman S, Strebel A, Cloete A, Henda N, et al. (2007) Internalized stigma, discrimination, and depression among men and women living with HIV/AIDS in Cape Town, South Africa. *Soc Sci Med* 64: 1823–1831.
- Tsai AC, Bangsberg DR, Frongillo EA, Hunt PW, Muzoora C, et al. (2012) Food insecurity, depression and the modifying role of social support among people living with HIV/AIDS in rural Uganda. *Soc Sci Med* 74: 2012–2019.
- Ciesla JA, Roberts JE (2001) Meta-analysis of the relationship between HIV infection and risk for depressive disorders. *Am J Psychiatry* 158: 725–730.
- Mello VA, Segurado AA, Malbergier A (2010) Depression in women living with HIV: clinical and psychosocial correlates. *Arch Womens Ment Health* 13: 193–199.
- Millikin CP, Rourke SB, Halman MH, Power C (2003) Fatigue in HIV/AIDS is associated with depression and subjective neurocognitive complaints but not neuropsychological functioning. *J Clin Exp Neuropsychol* 25: 201–215.
- Eller LS (2001) Quality of life in persons living with HIV. *Clin Nurs Res* 10: 401–423.
- Valente SM (2003) Depression and HIV disease. *J Assoc Nurses AIDS Care* 14: 41–51.
- Tsai AC, Weiser SD, Petersen ML, Ragland K, Kushel MB, et al. (2010) A marginal structural model to estimate the causal effect of antidepressant medication treatment on viral suppression among homeless and marginally housed persons with HIV. *Arch Gen Psychiatry* 67: 1282–1290.
- Cook JA, Cohen MH, Burke J, Grey D, Anastos K, et al. (2002) Effects of depressive symptoms and mental health quality of life on use of highly active antiretroviral therapy among HIV-seropositive women. *J Acquir Immune Defic Syndr* 30: 401–409.
- Burack JH, Barrett DC, Stall RD, Chesney MA, Ekstrand ML, et al. (1993) Depressive symptoms and CD4 lymphocyte decline among HIV-infected men. *JAMA* 270: 2568–2573.
- Evans DL, Ten Have TR, Douglas SD, Gettes DR, Morrison M, et al. (2002) Association of depression with viral load, CD8 T lymphocytes, and natural killer cells in women with HIV infection. *Am J Psychiatry* 159: 1752–1759.
- Ickovics JR, Hamburger ME, Vlahov D, Schoenbaum EE, Schuman P, et al. (2001) Mortality, CD4 cell count decline, and depressive symptoms among HIV-seropositive women: longitudinal analysis from the HIV Epidemiology Research Study. *JAMA* 285: 1466–1474.
- Antelman G, Kaaya S, Wei R, Mbwanjo J, Msamanga GI, et al. (2007) Depressive symptoms increase risk of HIV disease progression and mortality among women in Tanzania. *J Acquir Immune Defic Syndr* 44: 470–477.
- Cook JA, Grey D, Burke J, Cohen MH, Gurtman AC, et al. (2004) Depressive symptoms and AIDS-related mortality among a multisite cohort of HIV-positive women. *Am J Public Health* 94: 1133–1140.
- James JS (2004) Chronically depressed women with HIV almost twice as likely as others to die from AIDS-related causes; those with mental-health services had half the death rate of those without. *AIDS Treat News*: 2–3.
- Cohen MH, Fabri M, Cai X, Shi Q, Hoover DR, et al. (2009) Prevalence and predictors of posttraumatic stress disorder and depression in HIV-infected and at-risk Rwandan women. *J Womens Health (Larchmt)* 18: 1783–1791.
- Stein MD, Hanna L (1997) Use of mental health services by HIV-infected women. *J Womens Health* 6: 569–574.
- Valverde EE, Purcell DW, Waldrop-Valverde D, Malow R, Knowlton AR, et al. (2007) Correlates of depression among HIV-positive women and men who inject drugs. *J Acquir Immune Defic Syndr* 46 Suppl 2: S96–100.
- Nduna M, Jewkes RK, Dunkle KL, Shai NP, Colman I (2010) Associations between depressive symptoms, sexual behaviour and relationship characteristics: a prospective cohort study of young women and men in the Eastern Cape, South Africa. *J Int AIDS Soc* 13: 44.
- Smit J, Myer L, Middelkoop K, Seedat S, Wood R, et al. (2006) Mental health and sexual risk behaviours in a South African township: a community-based cross-sectional study. *Public Health* 120: 534–542.
- Filson J, Ulloa E, Runfola C, Hokoda A (2010) Does powerlessness explain the relationship between intimate partner violence and depression? *J Interpers Violence* 25: 400–415.
- Ellsberg M, Jansen HA, Heise L, Watts CH, Garcia-Moreno C, et al. (2008) Intimate partner violence and women's physical and mental health in the WHO multi-country study on women's health and domestic violence: an observational study. *Lancet* 371: 1165–1172.
- Campbell R, Sullivan CM, Davidson I, William S (1995) Women who use domestic violence shelters: Changes in depression over time. *Psychology of Women Quarterly* 19: 237–255.
- Weiser SD, Tsai A, Senkungu J, Emenyonu N, Kawuma A, et al. (2010) Effect of Low Sexual-Relationship Power on Viral Load Suppression among Women Receiving ART in Mbarara, Uganda. 17th Conference on Retroviruses and Opportunistic Infections. San Francisco, CA.
- Siedner MJ, Tsai AC, Dworkin S, Mukiiibi NF, Emenyonu NI, et al. (2012) Sexual Relationship Power and Malnutrition Among HIV-Positive Women in Rural Uganda. *AIDS Behav* 2012 Mar 2. [Epub ahead of print].
- Gove WR, Hughes M, Style CB (1983) Does marriage have positive effects on the psychological well-being of the individual? *J Health Soc Behav* 24: 122–131.
- Ross CE, Mirowsky J, Goldstein K (1990) The impact of the family on health: The decade in review. *Journal of Marriage and the Family*: 1059–1078.
- Kawachi I, Berkman LF (2001) Social ties and mental health. *J Urban Health* 78: 458–467.
- Kim HK, McKenry PC (2002) The relationship between marriage and psychological well-being. *Journal of Family Issues* 23: 885–911.
- Kiecolt-Glaser JK, Fisher LD, Ogrocki P, Stout JC, Speicher CE, et al. (1987) Marital quality, marital disruption, and immune function. *Psychosom Med* 49: 13–34.
- Farmer P, Connors M, Simmons J (1996) Women, poverty, and AIDS: sex, drugs, and structural violence: Common Courage Pr.
- Geng EH, Bwana MB, Kabakyenga J, Muyindike W, Emenyonu NI, et al. (2010) Diminishing availability of publicly funded slots for antiretroviral initiation among HIV-infected ART-eligible patients in Uganda. *PLoS One* 5: e14098.
- Pulerwitz J, Gortmaker SL, DeJong W (2000) Measuring sexual relationship power in HIV/STD research. *Sex Roles* 42: 637–660.
- Dunkle KL, Jewkes RK, Brown HC, Gray GE, McIntyre JA, et al. (2004) Gender-based violence, relationship power, and risk of HIV infection in women attending antenatal clinics in South Africa. *Lancet* 363: 1415–1421.
- Ketchen B, Armistead L, Cook SL (2009) HIV infection, stressful life events, and intimate relationship power: The moderating role of community resources for black South African women. *Women & health* 49: 197.
- Connell RW (1985) Theorising gender. *Sociology* 19: 260.
- Bolton P, Ndongoni L (2001) Cross-cultural assessment of trauma-related mental illness (Phase II): a report of research conducted by World Vision Uganda and The Johns Hopkins University.
- Martinez P, Andia I, Emenyonu N, Hahn JA, Hauff E, et al. (2008) Alcohol use, depressive symptoms and the receipt of antiretroviral therapy in southwest Uganda. *AIDS Behav* 12: 605–612.
- Bolton P (2001) Cross-cultural validity and reliability testing of a standard psychiatric assessment instrument without a gold standard. *J Nerv Ment Dis* 189: 238–242.
- Epino HM, Rich ML, Kaigamba F, Hakizamungu M, Soccia AR, et al. (2012) Reliability and construct validity of three health-related self-report scales in HIV-positive adults in rural Rwanda. *AIDS Care*.

49. Wu AW, Revicki DA, Jacobson D, Malitz FE (1997) Evidence for reliability, validity and usefulness of the Medical Outcomes Study HIV Health Survey (MOS-HIV). *Qual Life Res* 6: 481–493.
50. Wu AW, Rubin HR, Mathews WC, Ware JE, Jr., Brysk LT, et al. (1991) A health status questionnaire using 30 items from the Medical Outcomes Study. Preliminary validation in persons with early HIV infection. *Med Care* 29: 786–798.
51. Shahriar J, Delate T, Hays RD, Coons SJ (2003) Commentary on using the SF-36 or MOS-HIV in studies of persons with HIV disease. *Health Qual Life Outcomes* 1: 25.
52. Revicki DA, Sorensen S, Wu AW (1998) Reliability and validity of physical and mental health summary scores from the Medical Outcomes Study HIV Health Survey. *Med Care* 36: 126–137.
53. Babikako HM, Neuhauser D, Katamba A, Mupere E (2010) Feasibility, reliability and validity of health-related quality of life questionnaire among adult pulmonary tuberculosis patients in urban Uganda: cross-sectional study. *Health Qual Life Outcomes* 8: 93.
54. Bradley KA, Bush KR, Epler AJ, Dobie DJ, Davis TM, et al. (2003) Two brief alcohol-screening tests From the Alcohol Use Disorders Identification Test (AUDIT): validation in a female Veterans Affairs patient population. *Arch Intern Med* 163: 821–829.
55. Bush K, Kivlahan DR, McDonell MB, Fihn SD, Bradley KA (1998) The AUDIT alcohol consumption questions (AUDIT-C): an effective brief screening test for problem drinking. Ambulatory Care Quality Improvement Project (ACQUIP). Alcohol Use Disorders Identification Test. *Arch Intern Med* 158: 1789–1795.
56. Derogatis LR, Lipman RS, Rickels K, Uhlenhuth EH, Covi L (1974) The Hopkins Symptom Checklist (HSCL). A measure of primary symptom dimensions. *Mod Probl Pharmacopsychiatry* 7: 79–110.
57. Low-Beer S, Chan K, Yip B, Wood E, Montaner JS, et al. (2000) Depressive symptoms decline among persons on HIV protease inhibitors. *J Acquir Immune Defic Syndr* 23: 295–301.
58. Rabkin JG, Ferrando SJ, Lin SH, Sewell M, McElhiney M (2000) Psychological effects of HAART: a 2-year study. *Psychosom Med* 62: 413–422.
59. Palar K, Wagner G, Ghosh-Dastidar B, Mugenyi P (2012) Role of antiretroviral therapy in improving food security among patients initiating HIV treatment and care in Uganda. *AIDS*.
60. Seligman ME (1974) Depression and learned helplessness.
61. Abramson LY, Seligman ME, Teasdale JD (1978) Learned helplessness in humans: critique and reformulation. *J Abnorm Psychol* 87: 49–74.
62. Mirowsky J, Ross CE (1989) Social causes of psychological distress: Aldine de Gruyter.
63. Grant RL (1978) The value of “learned helplessness” in understanding depression. *Am J Psychiatry* 135: 625.
64. Buchwald AM, Coyne JC, Cole CS (1978) A critical evaluation of the learned helplessness model of depression. *J Abnorm Psychol* 87: 180–193.
65. Miller WR, Seligman ME (1975) Depression and learned helplessness in man. *J Abnorm Psychol* 84: 228–238.
66. Li B, Piriz J, Mirrione M, Chung C, Proulx CD, et al. (2011) Synaptic potentiation onto habenula neurons in the learned helplessness model of depression. *Nature* 470: 535–539.
67. Bougarel L, Guitton J, Zimmer L, Vaugois JM, El Yacoubi M (2011) Behaviour of a genetic mouse model of depression in the learned helplessness paradigm. *Psychopharmacology (Berl)* 215: 595–605.
68. Maier SF (2001) Exposure to the stressor environment prevents the temporal dissipation of behavioral depression/learned helplessness. *Biol Psychiatry* 49: 763–773.
69. Petty F, Kramer GL, Wu J, Davis LL (1997) Posttraumatic stress and depression. A neurochemical anatomy of the learned helplessness animal model. *Ann N Y Acad Sci* 821: 529–532.
70. Hajszan T, Dow A, Warner-Schmidt JL, Szigeti-Buck K, Sallam NL, et al. (2009) Remodeling of hippocampal spine synapses in the rat learned helplessness model of depression. *Biol Psychiatry* 65: 392–400.
71. Amaro H, Raj A (2000) On the margin: Power and women’s HIV risk reduction strategies. *Sex Roles* 42: 723–749.
72. Wingood GM, DiClemente RJ (2000) Application of the theory of gender and power to examine HIV-related exposures, risk factors, and effective interventions for women. *Health Educ Behav* 27: 539–565.
73. Bermudez MP, Castro A, Gude F, Bucla-Casal G (2010) Relationship power in the couple and sexual double standard as predictors of the risk of sexually transmitted infections and HIV: multicultural and gender differences. *Curr HIV Res* 8: 172–178.
74. Hahm HC, Lee J, Rough K, Strathdee SA (2012) Gender power control, sexual experiences, safer sex practices, and potential HIV risk behaviors among young Asian-American women. *AIDS Behav* 16: 179–188.
75. Wingood GM, Scd, DiClemente RJ (2000) Application of the theory of gender and power to examine HIV-related exposures, risk factors, and effective interventions for women. *Health Educ Behav* 27: 539–565.
76. Landstedt E, Asplund K, Gillander Gadin K (2009) Understanding adolescent mental health: the influence of social processes, doing gender and gendered power relations. *Sociol Health Illn* 31: 962–978.
77. Chonody JM, Siebert DC (2008) Gender Differences in Depression. *Affilia* 23: 338–348.
78. Hahm HC, Lee J, Rough K, Strathdee SA (2011) Gender Power Control, Sexual Experiences, Safer Sex Practices, and Potential HIV Risk Behaviors Among Young Asian-American Women. *AIDS Behav*.
79. Pettifor AE, Measham DM, Rees HV, Padian NS (2004) Sexual power and HIV risk, South Africa. *Emerg Infect Dis* 10: 1996–2004.
80. Saraceno B, van Ommeren M, Batniji R, Cohen A, Gureje O, et al. (2007) Barriers to improvement of mental health services in low-income and middle-income countries. *Lancet* 370: 1164–1174.
81. Chisholm D, Flisher AJ, Lund C, Patel V, Saxena S, et al. (2007) Scale up services for mental disorders: a call for action. *Lancet* 370: 1241–1252.
82. Eaton J, McCay L, Semrau M, Chatterjee S, Baingana F, et al. (2011) Scale up of services for mental health in low-income and middle-income countries. *Lancet* 378: 1592–1603.
83. Tomlinson M, Rudan I, Saxena S, Swartz L, Tsai AC, et al. (2009) Setting priorities for global mental health research. *Bull World Health Organ* 87: 438–446.
84. Piccinelli M, Wilkinson G (2000) Gender differences in depression. Critical review. *Br J Psychiatry* 177: 486–492.
85. Sherr L, Clucas C, Harding R, Sibley E, Catalan J (2011) HIV and depression—a systematic review of interventions. *Psychol Health Med* 16: 493–527.
86. Yang X (2011) Prevalence and correlates of HIV unsafe sex and STIs among women working in China’s entertainment industry. *AIDS Care* 23 Suppl 1: 75–82.
87. Shannon K, Leiter K, Phaladze N, Hlanze Z, Tsai AC, et al. (2012) Gender inequity norms are associated with increased male-perpetrated rape and sexual risks for HIV infection in Botswana and Swaziland. *PLoS One* 7: e28739.
88. Pulerwitz J, Amaro H, De Jong W, Gortmaker SL, Rudd R (2002) Relationship power, condom use and HIV risk among women in the USA. *AIDS Care* 14: 789–800.
89. Weeks MR, Hilario H, Li J, Coman E, Abbott M, et al. (2010) Multilevel social influences on female condom use and adoption among women in the urban United States. *AIDS Patient Care STDS* 24: 297–309.
90. Gagnon AJ, Merry L, Bocking J, Rosenberg E, Oxman-Martinez J (2010) South Asian migrant women and HIV/STIs: knowledge, attitudes and practices and the role of sexual power. *Health Place* 16: 10–15.