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Functional impairment and health care utilization among HIV-infected men who have sex with men: the relationship with depression and post-traumatic stress

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Abstract

This study examined the relationship of post-traumatic and depressive symptom severity with measures of health-related quality of life (HRQOL), and health care utilization in a sample of 503 HIV-infected men who have sex with men (MSM) recruited in their primary HIV care setting. Participants completed computer assisted assessments of mood and anxiety, HRQOL, and HIV treatment. Peripheral blood CD4 (T helper) lymphocyte count, plasma HIV RNA concentration, and number of medical appointments were extracted from an electronic medical record. Controlling for demographics, disease stage, and antiretroviral medication, post-traumatic stress and depression symptoms accounted for significant variation in general health estimates, and in pain, role, and work-related impairment. Additionally, in multivariable models, post-traumatic stress and depression severity accounted for significant variation in health care utilization whereas symptoms and indices of HIV disease progression did not. These results extend the current research by providing evidence of the relationship between post-traumatic stress and depression symptom severity with measures of functional impairment and health care utilization in a relatively healthy, urban cohort of HIV-infected MSM.

Keywords

HIV; Health related quality of life; Health care utilization; Depression; Post-traumatic stress

Introduction

With the success of antiretroviral medication regimens at controlling viral replication, delaying symptom onset, and extending survival, functional estimates of health such as health-related quality of life (HRQOL) assume high significance because people living with HIV anticipate greater life expectancy (Schackman et al. 2006). The relevance of HRQOL is also underscored by its relationship to the biological markers of HIV disease progression (Campsmith et al. 2003; Dobalian et al. 2004; Gill et al. 2002), HIV disease stage and symptom burden (Lorenz et al. 2006; Vidrine et al. 2003), and HIV survival (Cunningham et al. 2007; Jacobson et al. 2003; Mathews and May 2007).

People living with HIV have high levels of lifetime stress (Ironson et al. 2005; Leserman et al. 2005, 2007). For example, Leserman et al. (2005) found that more than half of a large cohort of HIV infected adults reported a history of either sexual or physical abuse. Moreover, more than 70% of the sample had experienced at least two lifetime traumas. Other common life stressors among HIV-infected adults include job loss, interpersonal rejection, bereavement, and symptom onset (Leserman 2003; O'Cleirigh et al. 2003). The presence of high levels of life stress may constitute an increased vulnerability for specific psychopathological disorders, particularly post-traumatic stress disorder (PTSD) and depression (O'Cleirigh et al. 2007b). In fact, the prevalence of diagnostic levels of depression and PTSD have been estimated as high as 37 and 54% respectively in patients with HIV (Bing et al. 2001; Dew et al. 1997; O'Cleirigh et al. 2007a).

The presence of either depression or post-traumatic stress in people living with HIV may well confer multiple risks. Both depression (Ironson et al. 2005; Kemeny and Dean 1995; Leserman et al. 1999, 2002) and stressful life events (Ironson et al. 2005; Kemeny and Dean 1995; Leserman et al. 2007) have been linked to more rapid disease progression and poorer survival. The presence of depression or life stress has also been associated with impaired performance of health behaviors (Chesney et al. 2000; Mugavero et al. 2007; Vanable et al. 2006), and increased rates of health risk behaviors (Ibanez et al. 2005; Pence et al. 2006) in people living with HIV. In addition, it is possible that depression- or PTSD-related neuroendocrine dysregulation may be of critical importance as these stress hormones represent potential pathways linking psychological stress response to poorer health outcomes in HIV (Schneiderman et al. 2005).

The strongest demonstration of the relationship between PTSD symptom severity and HRQOL in patients with HIV is reported by Leserman et al. (2005) from their study of over 600 diverse patients with advanced disease receiving services at 8 HIV clinics in 5 southern states. This study found that PTSD symptoms were significantly associated with more pain, poorer physical and role functioning, and increased utilization of health care services in the previous 9 months. PTSD symptom severity, trauma history and stressful life events accounted for up to 27% of the variance in health related functioning, and these results maintained after controlling for CD4 cell count and HIV viral load. Several other studies have reported significant relationships between stressful and traumatic life events and self-reported estimates of functional health status (Jones et al. 2003; Simoni and Ng 2002). In addition, Smith et al. (2002) reported that meeting the diagnostic cut-off for PTSD was significantly associated with greater pain intensity, and greater pain-related impairment in a group of 145 men and women with HIV. Although relationships consistent with Leserman et al. (2005) emerge from these studies, these findings are based predominantly upon small samples of HIV-infected women, and most of these studies do not control for disease stage. Furthermore, no studies have been undertaken examining these relationships in HIV-infected men who have sex with men (MSM).

Similarly, there is a lack of research examining the relationship between depression and HRQOL among MSM, who represent the largest proportion of individuals living with HIV/AIDS in the U.S. One report from the Multicenter AIDS Cohort Study (Liu et al. 2006) examined multiple predictors of HRQOL in a large sample of over 600 HIV-infected MSM after starting highly active anti-retroviral therapy (HAART). In the univariate analyses, depression was significantly associated with both physical and psychological components of HRQOL. In the multivariate analysis controlling for a range of other significant predictors, depression was significantly predictive of lower psychological HRQOL after starting HAART. Also within a longitudinal design, Jia et al. (2004) examined the predictors of change in HRQOL over 12 months in a sample of over 200 HIV-infected men. Baseline depression significantly predicted diminished role functioning and poorer general health and emotional well being at one-year follow-up. Depressive symptoms have also been related cross-sectionally to lower estimates of HRQOL in diverse samples of patients with HIV (Trépanier et al. 2005; Williams et al. 2005). There has been recent debate concerning the possible interdependence of PTSD and depression more broadly and ongoing examination of the independence of PTSD and depression constructs (e.g., Breslau et al. 2000). More recent examinations of the interrelationships between depression and PTSD in those suffering a traumatic injury provides some evidence of the independence of these constructs (O'Donnell et al. 2004).

In addition to reducing estimates of HRQOL, depression and trauma histories may also place HIV-infected individuals at risk for excessive or inappropriate use of health care resources. For example, Eisenman et al. (2003) reported that among a diverse cohort of adults with HIV who had been victims of violence, MSM were more likely than other patient groups to report emergency room visits. Leserman et al. (2005) reported that patients with more severe trauma histories were more likely to have had emergency room visits, inpatient care, and 4 or more HIV outpatient clinic visits in the previous 9 months. Comparing HIV-infected women with and without histories of physical or sexual abuse, Liebschutz et al. (2000) reported that women with abuse histories were more likely to have emergency room visits and hospitalizations over 2 years of follow-up. Depression has also been significantly associated with greater health care costs among HIV-infected Medicaid patients (Sambamoorthi et al. 2000) and with higher spending on health care, due to a greater use of inpatient and emergency services, among a nationally representative sample of over 2,200 HIV-infected adults (Joyce et al. 2005).

There is a notable lack of research articulating the relationship between symptoms of depression and post-traumatic stress with functional impairment and health care utilization in HIV-infected MSM. Much of the research has focused on women or diverse samples. An examination of these relationships among HIV-infected MSM is important for several reasons. Firstly, MSM continue to represent the largest group of new HIV infections nationally (Centers for Disease Control 2007) and identifying the psychosocial impediments to HRQOL in this group is a public health priority. Secondly, rates of PTSD among HIV-infected MSM are higher compared to nationally representative samples (Tsao et al. 2004), other patient groups (Tedstone and Tarrier 2003), and other HIV-infected individuals (Kelly et al. 1998). Similarly, rates of depression are also high among HIV-infected MSM (Bing et al. 2001; Dew et al. 1997). Thirdly, Stall et al. (2003) provide compelling evidence that depression and post-traumatic stress symptom vulnerabilities (childhood sexual abuse history or partner violence) combine syndemically to increase health risk behavior and vulnerability to HIV among MSM. It is plausible that high rates of depression and post-traumatic stress symptoms in HIV-infected MSM may also interact to negatively impact HRQOL and other health outcomes. Finally, there is also some initial evidence that HIV-infected MSM appraise their HRQOL significantly differently than other HIV-infected groups (Vidrine et al. 2003).

The purpose of the current study is to address the gap in the research literature by examining the relationship between post-traumatic stress and depression symptoms with measures of HRQOL and health care utilization among a group of HIV-infected MSM who receive care at an ambulatory HIV care center in the urban Northeast. Specifically, we hypothesized that post-traumatic stress symptom severity and depression would be significantly and negatively related to measures of HRQOL and positively related to health care utilization among HIV-infected MSM, after controlling for demographics, CD4 lymphocytes, HIV viral load and current antiretroviral treatment.

Methods

Sample and data

The sample consisted of 503 HIV-infected MSM who received primary care at Fenway Health (FH) in Boston, MA, the largest ambulatory HIV care center in New England. The data analyzed in the current study were derived from baseline assessments of men who were screened for participation in one of two parallel secondary behavioral interventions conducted at FH, which were intended to decrease unsafe sex with sexual partners of HIV-negative and unknown status (Knausz et al. 2007). All participants were administered a computer-assisted, comprehensive questionnaire that assessed demographic and psychosocial variables at baseline. The data for this study come from all participants at baseline, regardless of their participation in the interventions. The Fenway Health Institutional Review Board approved all study procedures and informed consent was received from all participants. Data on biological markers of HIV-infection (including peripheral blood CD4 count and plasma HIV RNA concentration) were collected via medical record extraction.

Measures

Primary outcome variables

HRQOL: Participants were asked 10 questions related to quality of life in the self-administered questionnaire. Composite measures for each of these HRQOL outcomes were constructed based on two or four survey items and were scored according to the ACTG QOL 601–602 Health Survey Manual (Bozzette et al. 1995; Wu 1999). Accordingly, all scores were transformed to a 0–100 scale, with higher scores reflecting higher functioning and lower scores reflecting greater functional impairment. The HRQOL outcomes were constructed from the following items:

1. 'General Health': (1) a general health rating, which was scored on a 5-point Likert scale from 'Poor' to 'Excellent'; and (2) a scale of health, scored from 0 ('Death') to 100 ('Perfect Health').
2. 'Functioning without Pain': (1) amount of bodily pain in the past 4 weeks, scored on a 6-point Likert scale from 'None' to 'Very Severe'; and (2) the extent to which pain interfered with normal work scored on a 5-point Likert scale from 'Not at all' to 'Extremely'.
3. 'Role Functioning': (1) whether or not health had impaired working at a job, doing work around the house, or going to school in the past 4 weeks, which was scored on a 3-point Likert scale including: 'No', 'Yes, some of the time', and 'Yes, for all of the time'; and (2) the extent to which certain kinds or amounts of work, housework, or schoolwork had been impaired due to health problems, scored on a 5-point Likert scale from 'None' to 'Very Severe'.
4. 'Physical functioning' was constructed from four items inquiring about how health problems limited certain activities, including: (1) vigorous activities (e.g., lifting

heavy objects, running, or participating in strenuous sports); (2) moderate activities (e.g., moving a table or carrying groceries); (3) walking uphill or climbing stairs; and (4) eating, dressing, bathing, or using the toilet. These items were scored on a 3-point Likert scale including: 'No', 'Yes, some of the time', and 'Yes, for all of the time'.

Health Care Utilization: Participants were asked how many medical visits they made within the past 6 months to all clinics and hospitals.

Independent variables—The demographic variables included age and education (a dichotomous variable defined as having less than a college education). Three variables were used to capture the HIV disease stage and treatment profiles of the participants: (1) CD4 count, measured in cells/mm³, (2) mean plasma HIV RNA (viral load), measured in copies per milliliter, and (3) whether participants reported currently taking antiretroviral therapy.

Post-traumatic stress symptom severity: The four-item SPAN (Meltzer-Brody et al. 1999) was the PTSD screening measure. Respondents rated the extent to which they were distressed by the four symptoms (startle, physically upset by reminders, anger, and numbness) during the past week. The SPAN has been found to have a diagnostic accuracy of 88%, sensitivity of 0.84, and specificity of 0.91 (Meltzer-Brody et al. 1999).

Depression symptoms: Depression symptoms were measured by the 9-item depression severity scale of the Patient Health Questionnaire (Spitzer et al. 1999), which provides diagnostic and symptom severity assessments. The PHQ is used to help primary care providers identify and diagnose mental health disorders. The PHQ depression severity scale has demonstrated high internal consistency (Cronbach's α : 0.89), test-retest reliability (r = 0.84), and strong construct validity (Kroenke et al. 2001).

Data analysis

Descriptive statistics were conducted for all variables of interest, and the correlation between each variable in the study was assessed. Next a set of four multiple sequential linear regression models were fit for each HRQOL outcome. In the first step, only demographic variables (i.e., age and education) were included in the model, and in the second step, we added the HIV disease stage and treatment variables. In the third and fourth steps, PTSD severity and depression symptoms were added respectively, based on the desire to examine the effects of these variables over and above biomedical indicators of disease stage and demographic covariates. The addition of PTSD and depression symptom severity in successive steps of the regression models allowed for an examination of the unique and additive effects of these variables on functional impairment outcomes. In the final step the interaction of PTSD and depression severity was added into the model, which allowed for an examination of the multiplicative effects of both over and above the individual effects of either.

For the health care utilization outcome, multiple linear regression analyses were conducted to examine the relationship between post-traumatic stress severity and depression symptoms with health care utilization, over and above the effects of the demographic and HIV disease stage and treatment variables.

Results

The demographic and HIV-related disease profile of the sample is presented in Table 1. The average age of the sample was 41.9 (SD: 8.3); three quarters of the sample were Caucasian,

11.3% were African-American/Black, and 8.9% were Latino/Hispanic. About half of the participants had at least a college education and an annual income of <\$40,000 per year. On average, participants had a CD4 cell count of 529 cells/mm³ (SD: 296); 58.2% of the participants had detectable plasma HIV RNA, with sample mean plasma HIV RNA of 13,671 copies/ml (SD: 44,355; min: 75, max: 442,298). 69.6% of the participants were currently taking HIV medication (HAART).

The mean post-traumatic stress symptom severity score for the sample was 9.2 (SD: 7.0), ranging from 0 to 29 (Table 2). About 27% of the sample met screen-in criteria for PTSD, and the average number of depression symptoms was 1.7 (SD: 2.5), ranging from 0 to 9. Almost one quarter of the sample met screen-in criteria for either major depression or other depression and 8.5% ($n = 43$) of the sample met screen-in diagnostic criteria for both PTSD and major depressive disorder. Table 2 also presents the descriptive statistics for the HRQOL outcomes: (1) general health, (2) functioning without pain, (3) role functioning, and (4) physical functioning.

Relationship of post-traumatic stress and depression symptoms with HRQOL

The correlations between each of the variables in the study are presented in Table 3. Of note, all of the health-related quality of life indicators were significantly positively correlated with one another ($p < 0.01$), and significantly correlated with decreased health care utilization ($p < 0.01$). The psychopathology variables (PTSD symptom severity and depression symptoms) were significantly positively correlated ($r = 0.47$; $p < 0.01$). Regarding associations between the outcomes and the demographic, HIV-related, and psychopathology variables, having at least a college education was significantly correlated with greater functioning across all HRQOL outcomes and older age was significantly correlated with worse general health and worse physical functioning. Post-traumatic stress and depression severity were significantly correlated with worse functioning on all of the HRQOL outcomes. Higher CD4 levels were significantly correlated with better general health and better physical and pain related functioning whereas plasma HIV RNA concentration was not significantly correlated with any of the four HRQOL outcomes. Being on HAART was significantly correlated with worse general health and physical functioning. While PTSD symptom severity and depressive symptoms were significantly correlated with increased health care utilization, none of the demographic or HIV-related variables were significantly related to this outcome.

Table 4 presents the results of multiple linear regression analyses with all of the four health-related quality of life outcomes (general health, functioning without pain, role functioning, and physical functioning). For all four indicators of HRQOL, post-traumatic stress and depression indicators of disease severity (viral load and CD4), and being on HAART. It should be noted that the order of entry of depression and PTSD severity into the regression models does not alter the pattern of significant relationships with the outcomes: in all cases when depression was entered into the regression model before PTSD, depression was significantly related to each of the outcomes and maintained its significance when PTSD severity was entered. Similarly, PTSD severity was significantly related to each of the outcomes when entered into the models following depression.

General health—Increased plasma HIV RNA, decreased CD4 counts, and being on HAART were each associated with poorer general health, over and above age and education, explaining an additional 5.0% of the variation in the outcome. Post-traumatic stress accounted for an additional 6.9% of significant unique variation when entered in step 3, and depressive symptoms accounted for an additional 8.4% of significant unique variation when entered in step 4. The interaction between PTSD and depression symptom severity was

entered in step 5 which also accounted for significant variation (1%) in general health. In this final step (step 5), post-traumatic stress symptoms, depressive symptoms, and their interaction, being on HAART, viral load, and CD4 were all unique predictors and accounted for 24.3% of the variation in general health.

Functioning without pain—Neither the biological markers of HIV (plasma HIV RNA or CD4 count) nor being on HAART was uniquely associated with functioning without pain. As with the other aspects of HRQOL, in the final step, depression and post traumatic stress were each significantly negatively associated with the functioning without pain, after controlling for each other and the other covariates, although the interaction between PTSD and depression severity did not contribute significantly to the explained variance. Together, these variables accounted for 13.7% of the variation in functioning without pain.

Role functioning—In the analysis of role functioning, neither indicator of disease severity was significantly associated with role functioning, but being on HAART was. In steps 3 and 4, depression and post-traumatic stress were negatively associated with role functioning after controlling for all covariates in the model. The addition of the interaction of PTSD and depression severity in step 5 did not add significantly to the explained variance. Together, the demographic covariates, HIV disease severity measures, being on HAART, depression, and post-traumatic stress symptom severity accounted for 17.8% of the variation in role functioning.

Physical functioning—In the analysis of physical functioning, only CD4 count was significantly associated with physical functioning. This effect remained significant in the third and fourth steps where depression and post-traumatic stress were added, and they were both significantly negatively associated with physical functioning. In step 5 the interaction of PTSD and depression symptoms also accounted for significant variation (0.7%) in the model. Together, all of the variables in the final step accounted for 23.9% of the variation in physical functioning.

Relationship of depression and post-traumatic stress severity with health care utilization

Table 5 depicts the multivariable relationships between the independent variables and health care utilization. Neither the demographic variables nor any of the HIV-related variables were significantly associated with health care utilization, and collectively, they contributed to only 0.7% of its variation. Both post-traumatic stress (step 3) and depressive symptoms (step 4) were significantly associated with greater health care utilization and these variables accounted for an additional 2.8 and 1.2% respectively of the variation in this outcome. In step 5 the interaction of PTSD and depression symptom severity was also significantly related to health care utilization accounting for a modest 1.1% of the variation.

Discussion

This is the first study to identify significant relationships between post-traumatic stress and depression with measures of functional impairment in HIV-infected MSM, and to establish these relationships over and above the effects of disease progression as measured by CD4 lymphocyte count, plasma HIV RNA, and current antiretroviral therapy. Both post-traumatic stress symptom severity and depression contributed uniquely to explain significant variation in each of the HRQOL indices, including general health, functioning without pain, role functioning, and physical functioning. These findings are particularly relevant as post-traumatic stress and depression co-occur at high rates (O'Donnell et al. 2004) and there is strong evidence to suggest that both disorders are more prevalent among those with HIV than in the general population (see Bing et al. 2001; O'Cleirigh et al. 2007a). In fact, 27% of

this sample met screen in diagnostic criteria for PTSD and just under 22% met screen in criteria for any depressive disorder. In addition, there is a rich body of research demonstrating that both depression and high levels of life stress predict accelerated disease progression in people living with HIV (Ironson et al. 2005; Leserman et al. 2007).

These results are consistent with those reported by Leserman et al. (2005) who found that in combination with current stressful life events and trauma history, PTSD symptom severity accounted for up to 27% of the variation in health-related functioning controlling for CD4 cell count and HIV viral load. The current study extends the findings reported by Leserman and colleagues in several notable ways. Firstly, the median CD4 cell number ($CD4_{\text{median}} = 378$) reported by Leserman are substantially lower than in the current sample ($CD4_{\text{median}} = 489$). Additionally, the mean levels of impairment reported by Leserman et al. (2005) are considerably higher than in the current study, and estimates of functional impairment placed the Leserman cohort at about the 25th percentile compared to the general population. The current sample, however, reported only minimal levels of impairment across the indices and reported very high estimates of general health, as the mean general health rating was 57.7 out of 100. Thus, these findings establish significant relationships between post-traumatic stress symptom severity and depression with HRQOL among HIV-infected MSM and do so for a relatively healthy sample with lower levels of impairment. This extends previous findings by suggesting that first, the relationship between post-traumatic stress symptom severity and HRQOL may well hold across different samples of people with HIV, across different stages of HIV infection, and with differing levels of functional impairment, and second, that in addition to post-traumatic stress symptom severity, depression may be an important component in that relationship.

Post-traumatic stress symptom severity and depression accounted for comparably more of the variation in measures of general health and adaptive functioning than markers of HIV disease stage or its treatment. In fact, PTSD and depression symptom severity explained approximately 15% of unique variance in self-reported general health estimates whereas biological markers of disease progression and HAART accounted for only 5% of unique variance. Similar patterns emerged for the other three indices of functional impairment. For functioning in terms of pain, role, and physical functioning, post-traumatic stress symptom severity and depression accounted for between 8.9 and 14.8% of the variation in these estimates, whereas CD4 cell number, HIV viral load and HAART accounted for only a minimal (1–2%) and generally non-significant proportion of the variance. The results also suggest that the presence of high levels of both PTSD and depression symptom severity may well confer additional risk for greater functional impairment with respect to general health estimates, physical functioning, and health care utilization, although these effects are modest. This finding has particular relevance as depression is highly comorbid with PTSD and 8.5% of the study sample met diagnostic screen in criteria for both disorders. These findings suggest that measures of specific distress may be particularly relevant when evaluating HRQOL among HIV-infected MSM, particularly when self-reported estimates of adaptive functioning are high.

It is not possible within the limitations of the cross-sectional design of this study to identify the reported relationships as causal or even to specify the directionality of the results. However, we consider several putative mechanisms that may be operating. It is plausible that the presence of post-traumatic or depressive symptoms may lead to an increase in participants' perceived symptom burden, which may in turn raise their estimates of their own functional impairment. It is also possible that higher levels of post-traumatic stress and depressive symptoms may interfere with adaptive management of HIV (particularly around new symptom presentation or medication adherence) and the effects of post-traumatic stress symptom severity/depression on adaptive functioning are mediated through health

behaviors. It is also feasible that chronically high levels of distress may result in chronic activation of the hypothalamic pituitary adrenocortical (HPA) or sympathetic adrenal medullary (SAM) systems through higher circulating levels of cortisol and norepinephrine respectively. In fact there is evidence that PTSD and depression are associated with dysregulation of neuroendocrine function, specifically of norepinephrine and cortisol (van der Kolk 1997; Resnick et al. 1995). Elevated levels of both norepinephrine and cortisol have been independently linked to accelerated disease progression in HIV (Ironson et al. 2006; Leserman et al. 2000). It has been suggested that the stress hormones cortisol and norepinephrine represent the biological pathways linking psychological response to stress to poorer health outcomes in HIV (Schneiderman et al. 2005). These stress-related biological processes may impact functional impairment through either suppressed immune function or poorer response to HAART (Cole et al. 2001), both of which could plausibly result in poorer disease course or more rapid symptom onset and so to higher reported levels of impairment. It is also possible that lower levels of adaptive functioning and poorer health may exacerbate pre-existing symptoms of post-traumatic stress or depression and that the significant relationships reported here reflect the impact of disease process on psychopathology and not the other way around.

Being on HAART was significantly associated with poorer general health and poorer role functioning as depicted in Table 4. Again it is not possible to specify the direction of this effect but it is perhaps more plausible to hypothesize that poorer health estimates and functioning may increase the likelihood of being on HAART rather than that HAART contributes to poorer health outcomes.

Many of these relationships, particularly the hypothesized mediated pathways, await empirical verification and are a legitimate target for future investigations. Regardless of which pathways are operating however, it seems likely that an assessment of HIV-infected patients' post-traumatic stress and depression profile could help to inform patients' self-reports of their own health and functional status.

As hypothesized, post-traumatic stress symptom severity and depression were both significantly related to increased health care utilization. This finding is consistent with previous research (Joyce et al. 2005) that reported that depression was associated with significantly greater number of hospitalizations, inpatient services, and emergency room visits. Our results provide initial evidence suggesting that depression among HIV-infected MSM may significantly contribute to their medical care burden and may be a significant factor increasing the cost of HIV-related medical care in this group.

In addition to the study design issues discussed above, the findings from this study should be interpreted within the context of its limitations. Most of the measures, although validated, were based upon self-report and are vulnerable to the biases of that methodology. In addition, the measures of post-traumatic stress symptoms and depression identified those meeting "screen-in" criteria and were not clinician-administered diagnostic measures. The values for CD4 lymphocytes and HIV viral load were extracted from patient medical records and were not collected through standardized study procedures.

The results of this study suggest that the severity of post-traumatic stress symptoms or depressive symptoms in MSM managing HIV may well place them at risk for lower general health and may contribute to lower HRQOL through worse adaptive functioning. In addition, depression may also contribute to the cost of medical care in this group through its association with high utilization of primary health care. The relationships reported here are likely complex and may well be mediated behaviorally and physiologically. Longitudinal study designs examining these associations may be particularly well suited to elucidate the

complexities of these relationships. There is a developing cognitive-behavioral technology for treating depression in people with HIV (e.g., Safren et al. 2009), and although development of trauma related treatments in HIV is underway (i.e., Sikkema et al. 2008; Wyatt et al. 2004) empirically supported treatments for post-traumatic stress in HIV have yet to be established. As HIV-infected MSM may be particularly prone to both disorders, the symptoms of which appear to impact health, functional status, and high utilization of health care, the development of effective treatments for this vulnerable group must be a priority.

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Table 1Participant background and demographic characteristics ($n = 503$)

Characteristic	Mean (SD) or number (%)
Age (years)	41.9 (8.3)
Race/Ethnicity	
Caucasian	378 (75.1%)
Black/African American	57 (11.3%)
Hispanic/Latino	45 (8.9%)
Other	23 (4.7%)
Education	
Less than a college degree	243 (48.3%)
College degree	260 (51.7%)
Annual income	
Less than \$20,000	176 (35.5%)
\$20,001–40,000	108 (21.8%)
\$40,001–60,000	83 (16.7%)
> \$60,000	129 (26.0%)
CD4 count (cells/mm ³)	528.6 (296.2)
Viral load (mean plasma HIV RNA: copies/ml)	13,671 (44,355)
Currently taking HIV medication	
No	153 (30.4)
Yes	350 (69.6)

Table 2Descriptive Statistics of the psychopathology and health-related quality of life (HRQOL) indicators ($n = 503$)

Psychopathology indicators	Mean (SD)	Range
Post-traumatic stress disorder severity score	9.2 (7.0)	0–29
Depression symptoms	1.7 (2.5)	0–9
HRQOL category	Mean (SD)	Range
General health	57.7 (17.8)	3–87.5
Functioning without pain	48.4 (14.1)	0–63.8
Role functioning	46.5 (15.8)	0–58.7
Physical functioning	28.6 (7.9)	0–34.7

Table 3

Correlations between each of the variables in the study

	General health	Functioning without pain	Role functioning	Physical functioning	Health care utilization	Age	Education	CD4 count	Viral load	On HAART	PTSD severity	Depression symptoms
General health	1.00											
Functioning without pain	0.40**	1.00										
Role functioning	0.50**	0.52**	1.00									
Physical functioning	0.49**	0.54**	0.58**	1.00								
Health care utilization	-0.20**	-0.18**	-0.33**	-0.25**	1.00							
Age	-0.94*	-0.09	-0.05	-0.16**	-0.01	1.00						
Education	0.12**	0.12**	0.14*	0.14**	-0.03	0.16**	1.00					
CD4 count	0.15**	0.10*	0.09	0.11*	-0.07	0.05	0.08	1.00				
Viral load (log)	-0.07	-0.02	-0.01	0.05	0.02	-0.18**	-0.01	-0.31**	1.00			
On HAART	-0.09*	-0.05	-0.08	-0.11*	0.04	0.18**	0.02	0.08	-0.65**	1.00		
Post-traumatic stress severity	-0.28**	-0.26**	-0.36**	-0.28**	0.18**	0.00	-0.10*	-0.04	0.02	-0.02	1.00	
Depression symptoms	-0.41**	-0.30**	-0.31**	-0.39**	0.17**	-0.03	-0.21**	-0.05	0.13**	-0.05	0.47**	1.00

* $p < 0.05$
** $p < 0.01$

Table 4

Linear regression analyses examining the relationship between depression symptoms and post-traumatic stress symptom severity with 4 health-related quality of life outcomes: general health, functioning without pain, role functioning, and physical functioning

	General health					Functioning without pain				
	β : step 1	β : step 2	β : step 3	β : step 4	β : step 5	β : step 1	β : step 2	β : step 3	β : step 4	β : step 5
Age	-0.11*	-0.12*	-0.11*	-0.10*	-0.11*	-0.10	-0.10	-0.09*	-0.09*	-0.09*
Education ^b	0.16**	0.15**	0.12**	0.06	0.06	0.17**	0.16**	-0.13**	0.09*	0.09*
CD4 count		0.10*	0.09*	0.11*	0.11*		0.07	0.06	0.07	0.07
Viral load (log)		-0.20**	-0.20**	-0.14*	-0.13*		-0.05	-0.05	-0.01	0.01
On HAART ^c		-0.22**	-0.22**	-0.20**	-0.19**		-0.09	-0.09	-0.08	-0.07
PTSD severity			-0.26**	-0.11**	-0.12**			-0.23**	-0.14**	-0.15**
Depression symptoms				-0.34**	-0.40**				-0.21**	-0.26**
PTSD $\times$ depression					0.12*					0.10
ΔF	7.17**	8.43**	37.45**	50.46**	6.09*	7.48**	1.63	28.45**	17.72**	3.65
df	2,467	3,464	1,463	1,462	1,461	2,467	3,464	1,463	1,462	1,461
R^2	0.030	0.080	0.149	0.233	0.243	0.031	0.041	0.097	0.130	0.137
ΔR^2	0.030	0.050	0.069	0.084	0.010	0.031	0.010	0.056	0.033	0.007
	Role functioning					Physical functioning				
	β : step 1	β : step 2	β : step 3	β : step 4	β : step 5	β : step 1	β : step 2	β : step 3	β : step 4	β : step 5
Age	-0.09	-0.08	-0.08	-0.07	-0.08	-0.22**	-0.21**	-0.20**	-0.20**	-0.20**
Education	0.16**	0.15**	0.12**	0.08	0.08	0.18**	0.17**	0.14**	0.08*	0.09*
CD4 count		0.05	0.04	0.05	0.05		0.10*	0.09*	0.10*	0.11*
Viral load (log)		-0.09	-0.09	-0.06	-0.04		-0.02	-0.02	0.04	0.05
On HAART		-0.14*	-0.14*	-0.13*	-0.12*		-0.10	-0.10	-0.08	-0.08
PTSD severity			-0.29**	-0.17**	-0.18**			-0.26**	-0.11*	-0.11*
Depression symptoms				-0.26**	-0.29**				-0.34**	-0.39**
PTSD $\times$ depression					0.06					0.10*

	General health					Functioning without pain				
	β^a : step 1	β : step 2	β : step 3	β : step 4	β : step 5	β : step 1	β : step 2	β : step 3	β : step 4	β : step 5
ΔF	6.60**	2.39*	44.21**	28.16**	1.23	16.81**	2.86*	34.48**	50.73*	4.41*
df	2,467	3,464	1,463	1,462	1,461	2,467	3,464	1,463	1,462	1,461
R^2	0.027	0.042	0.126	0.176	0.178	0.067	0.084	0.148	0.232	0.239
ΔR^2	0.027	0.015	0.084	0.050	0.002	0.067	0.017	0.064	0.084	0.007

^a All β coefficients have been standardized

^b The referent group is having less than a college education

^c The referent group is not being on HAART

* $p < 0.05$

** $p < 0.01$

Table 5

Linear regression analyses examining the relationship of post-traumatic stress symptom severity and depression with health care utilization

	Health care utilization				
	β^1 : step 1	β : step 2	β : step 3	β : step 4	β : step 5
Age	-0.01	-0.01	-0.01	-0.02	-0.02
Education ^b	-0.22	-0.18	-0.02	-0.02	0.03
CD4 count		-0.05	-0.04	-0.05	-0.04
Viral load (log)		0.06	0.06	0.04	0.05
On HAART ^c		0.08	0.08	0.07	0.07
PTSD severity			0.17**	0.11*	0.10*
Depression symptoms				0.13*	0.07
PTSD $\times$ depression					0.123*
ΔF	0.13	1.03	13.51**	5.57**	5.27*
df	2,467	3,464	1,463	1,462	1,461
R^2	0.001	0.007	0.035	0.047	0.058
ΔR^2	0.001	0.006	0.028	0.012	0.011

^a All β coefficients have been standardized

^b The referent group is having less than a college education

^c The referent group is not being on HAART

* $p < 0.05$

** $p < 0.01$