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The Impact of Depression and Post-traumatic Stress Symptoms on Physical Health Perceptions and Functional Impairment among Sexual Minority Men Living with HIV with Histories of Trauma

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Abstract

Mental health symptoms may compromise health-related quality of life (HRQOL), including among men who have sex with men (MSM) living with HIV, who experience high rates of trauma and other stressors. This study sought to examine the relative contributions of post-traumatic stress disorder (PTSD) symptoms, depression symptoms, and biological indices of HIV disease status on HRQOL in this population. Participants were 79 MSM with HIV (49% White; 35% Black; 8% Hispanic/Latinx) with trauma histories (52% met current PTSD diagnostic criteria). HRQOL outcomes were general perceptions of health (0-100 visual analog scale) and functional disability (WHODAS 2.0). Dominance analysis was applied to examine the relative share of variance in these outcomes accounted for by PTSD symptom severity, depression symptom severity, viral suppression status, and CD4 count. Depression symptom severity accounted for 70% and 92% of variance in perceived health, respectively, across models (p's < 0.05). Both PTSD symptom severity (45%) and depression symptom severity (43%) scores also accounted for significant variance in functional disability (p's < 0.05). Medical indices of HIV disease progression did not explain significant variance in HRQOL in any model. A trauma-informed approach may aid clinicians in interpreting reports of health and physical functioning in MSM with HIV.

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Keywords

HIV; Men who have sex with men; Trauma; Depression; Health-related quality of life; Minority stress model

INTRODUCTION

Health-related quality of life (HRQOL) has increasingly become a focus of clinical care for people living with HIV (PLWH) as advances in antiretroviral therapy (ART) have enabled large gains in life expectancy (Teeraananchai et al., 2017). In addition to its standalone importance as a clinical endpoint, improvements in HRQOL may also confer important benefits for HIV medical outcomes including HIV disease progression, HIV-related symptom burden, and mortality (Chukwurah et al., 2020; Gill et al., 2002; Jacobson et al., 2003; Lorenz et al., 2006; Mathews & May, 2007; Milanini et al., 2017). Functional aspects of health may therefore play an important role in optimizing HIV treatment outcomes.

One factor hindering HRQOL in PLWH is the high burden of lifetime stress experienced, particularly among men who have sex with men (MSM). The minority stress model posits that MSM experience increased discrimination, stigma, and social stress relative to their peers, resulting in increased risk for mental health problems (Hatzenbuehler, 2009; Hatzenbuehler & Pachankis, 2016; Meyer, 2003; Pachankis, 2007). Moreover, MSM experience high rates of lifetime trauma: estimated rates of childhood sexual abuse (CSA) range from 21.8% to 35.5% (Lenderking et al., 1997; Lloyd & Operario, 2012). CSA and resulting posttraumatic stress symptoms have been shown to increase HIV infection risk and other adverse health outcomes among MSM (Brezing et al., 2015; Mimiaga et al., 2009; Noor et al., 2020). In PLWH, these experiences often overlay additional stressors, such as interpersonal rejection, HIV symptom onset, and adult sexual trauma revictimization (Fazeli et al., 2017; O'Cleirigh et al., 2003; Pantalone et al., 2015).

Exposure to physical or sexual violence in early life is not only associated with increased risk of posttraumatic stress disorder (PTSD), but also with co-morbid psychological disorders such as major depressive disorder (MDD) and substance use disorders (Duncan et al., 1996; Kilpatrick et al., 2003). A sizeable body of research has examined the co-occurrence of PTSD and MDD, indicating that approximately half of people with PTSD also experience clinically significant depressive symptoms (Kessler et al., 1995; Rytwinski et al., 2013). Despite symptom overlap, network analysis has shown distinct relationships between specific PTSD and MDD symptom clusters and associated health behavior outcomes within MSM with histories of CSA (Choi et al., 2017). The cumulative burden of these co-morbid conditions is associated with increased health-related disability, as well as increased healthcare utilization and HIV disease progression in HIV-positive MSM (Batchelder et al., 2019; Boarts et al., 2006; Cruess et al., 2003; Glynn et al., 2019; Nichter et al., 2019).

Despite these links, there remains a lack of research examining the specific relationships between PTSD and depression symptoms and perceived health and functional impairment

in HIV-positive MSM. One prior study in over 500 relatively healthy urban HIV-positive MSM found that these mental health symptoms accounted for a significant share of variance in functional disability, over and above biological markers of HIV infection (O'Cleirigh et al., 2009). The present study seeks to corroborate and extend these findings by applying a novel analytic approach—i.e., dominance analysis—within a sample of urban HIV-positive MSM with histories of trauma. Dominance analysis provides a straightforward method for determining the relative importance of predictors when there is collinearity among the variable set by performing pairwise comparisons between independent variables in all possible subset regression models (Azen & Budescu, 2003; Budescu, 1993). In contrast to regression coefficients, which partition to each independent variable only the incremental variance explained above and beyond the most influential independent variable, dominance weights estimate the proportion of overall model variance accounted for by each of the independent variables (Azen & Budescu, 2003). In the present analysis, we seek to apply dominance analysis to examine the relative roles of post-traumatic stress and depression symptoms in shaping health perceptions and functional impairment in a sample of urban HIV-positive MSM with trauma histories.

MATERIALS AND METHODS

Trial design and procedures

This manuscript examines data collected during the baseline visit of a pilot randomized controlled trial conducted at Fenway Health in Boston, Massachusetts and Ryerson University in Toronto, Ontario. After informed consent, participants completed a self-report assessment battery. Trained clinicians assessed participants' mental health. Participants were compensated $50 for their participation in the baseline assessment. All procedures were approved by the Institutional Review Boards at Fenway Health and Ryerson University.

Participants and Recruitment

Seventy-nine participants completed a baseline assessment across the two study sites. Participants were recruited via flyers (posted in HIV clinics, AIDS service organizations, and community centers in Boston, MA and Toronto, Ontario), ads in online dating apps, and community referrals. Eligible participants reported: 1) male sex at birth and having sex with men, 2) HIV-positive, 3) experiencing a traumatic life event, and 4) sub-optimal engagement in HIV care, operationalized as presence of a) detectable viral load; b) one or more missed HIV care appointments in the past six months or two in the past year; or c) self-reported antiretroviral adherence lower than 80% in the past two weeks (Mugavero et al., 2013; Thompson et al., 2020; Viswanathan et al., 2015).

Assessment Measures

Participants completed the following self-report measures: 1) a demographics assessment, 2) the Center for Epidemiologic Studies Depression Scale (CES-D) as a measure of current depressive symptoms (Cronbach's alpha=0.90) (Radloff, 1977), 3) the Davidson Trauma Scale as a measure of current trauma-related distress (Cronbach's alpha=0.93) (Davidson et al., 1997), 4) the overall health perception item from the AIDS Clinical Trial Group Overall Health Status Assessment (0-100 visual analog scale) (Bozzette et al., 1995), and

5) the World Health Organization Disability Assessment Schedule (WHODAS) 2.0 to measure functional impairment (Cronbach's alpha = 0.92) (Üstün et al., 2010). Clinician-administered assessments included the MINI International Neuropsychiatric Interview (MINI) and Structured Clinical Interview for DSM-5 (SCID-5) for diagnosis of PTSD and MDD. Participants' most recent CD4 and HIV viral load values were abstracted from their electronic medical records.

Data analysis

Descriptive statistics were calculated for the sample's demographic and health characteristics. To assess for racial and ethnic differences in socioeconomic and health status, chi-squared analyses and independent sample *t*-tests compared members of the four most frequently represented racial and ethnic groups with the rest of the sample.

Two statistical approaches (hierarchical linear regression and dominance analysis) were used to examine relative contributions of psychological and HIV-related morbidity on MSM with trauma history's perceptions of health and functional impairment. As a complement to our dominance analysis approach (using complete data), the regression approach using multiple imputation served to mitigate potential bias and loss of power (Rubin, 1987).

A significant proportion of HIV health-related data were missing in the current sample (30% self-reported viral suppression data were missing, 44% chart-abstracted viral load data, and 47% chart-abstracted CD4 count data). These data appeared to be missing completely at random (MCAR) and therefore appropriate for multiple imputation, completed using *mice* package in R (Little & Rubin, 2014; van Buuren & Groothuis-Oudshoorn, 2010). Model R^2 variance was estimated using methods outlined by Harel (Harel, 2009).

Regression models were applied to the relations between the CES-D, DTS, viral suppression status, CD4 count, and the two dependent variables (perceived health and functional impairment), controlling for demographics.

We next performed dominance analyses to examine the relative importance of HIV-related health status indicators (HIV viral suppression status and CD4 count) and mental health indicators (CES-D and DTS) on perceived health and functional impairment (Azen & Budescu, 2003; Budescu, 1993). To further reduce potential bias and loss of power associated with missing data, CD4 count and HIV viral suppression were analyzed in separate models. As we were interested in overall predictor importance, we reported general dominance weights, which express the relative importance of each variable in terms of the estimated R^2 contribution to the model attributable to that predictor. To summarize the proportion of total variance attributable to each predictor, these weights were divided over the full model R^2 value and reported as percentages. Analyses were performed using the *dominanceAnalysis* package in R (Bustos & Coutinho Soares, 2020).

RESULTS

The demographic and HIV-related health characteristics of the sample are summarized in Table 1. The average age of the sample was 48.6 years (SD: 9.4). Participants tended to

have lower income (82% earned < $20,0000/year) and a range of education (10% had less than a high school degree; 61% had some college). On average, the sample reported that their health was poor (63.3/100, SD: 20.6). Functional disability was common, with a mean WHODAS score of 8.7 (SD: 8.9) on a scale of 0-48. Nearly all participants (97%) were on HAART. Participants had a median CD4 count of 633.5 cells/mm^3 (IQR: 444.5—852.3). 82% reported that their most recent HIV viral load was undetectable, comparable with 86% based on chart-abstracted values. Self-reported viral load showed good concordance with chart-abstracted values when both were available (94% agreement); thus, self-report was used in analyses due to decreased missingness.

Participants endorsed a range of trauma experiences: 48% reported childhood or adolescent sexual trauma, 63% intimate partner violence, and 56% childhood or adolescent physical abuse. 43% reported unwanted sexual experiences during adulthood. 51.8% met DSM-5 criteria for PTSD, and 42% endorsed a history of MDD. The average DTS for the sample was 46.1 (SD: 26.6), ranging from 0-107, and the average CES-D was 27.5 (SD: 11.4), with a range from 1-55.

Our sample was racially and ethnically diverse. Of 79 participants, 49% identified as White, 35% as Black or African American, 7% as Native American or Aboriginal/Indigenous Canadian. Other identities endorsed included Middle Eastern/North African/Arab (N=2), East or Southeast Asian (N=1), and South Asian (N=1). Six participants (8%) identified as Hispanic/Latinx. Table 1 compares sample characteristics across racial/ethnic groups. Black participants averaged older, and White participants younger, than the rest of the sample (p's < 0.05). Black participants reported experiencing more PTSD criterion A trauma events than others in the sample (82% reported two or more traumas), yet they perceived themselves to be healthier on average than others in the sample ($p < 0.05$). Conversely, White participants endorsed greater post-traumatic stress ($p < 0.05$) and depression ($p < 0.01$) symptom severity than others in the sample. Rates of PTSD diagnosis did not differ significantly by race.

Our primary study questions were tested by means of four dominance analysis models (Table 2).

General Health Perceptions.

Overall, HIV-related and mental health indicators accounted for about 25% of the variance in general health perceptions. General dominance weights indicated that depression symptom severity (CES-D) accounted for 70% of that variance when compared with post-traumatic stress (DTS) and self-reported HIV viral suppression status (Model A), and an even greater 92% of the variance relative to DTS and CD4 count (p's < 0.05) (Model B). DTS and viral suppression contributions were modest in size and were not significant predictors of perceived health. CD4 count did not contribute to perceived health.

Functional disability.

HIV-related and mental health indicators accounted for 31%-39% of the total variance in functional disability across our two models. Mental health factors remained the indicators of greatest relative importance in these models, with DTS score accounting for the greatest share of variance in functional disability (55%; $p < 0.05$) relative to CES-D (38%; $p =$

0.06, *n.s.*) and viral suppression (6%, *n.s.*) (Model C). When CD4 count replaced viral suppression in the model, both DTS (44%) and CES-D (42%) showed similar importance in their contribution to variance explained in functional disability (p's <0.05) (Model D). Viral load and CD4 count remained unimportant in their respective models (p's > 0.05; *n.s.*).

Our dominance analyses were accompanied by corresponding linear regression models (Table 3). These models corroborated the patterns of statistical significance demonstrated in our dominance analysis models while accounting for potential bias and loss of statistical power by imputing missing data. These models also demonstrated that the pattern of effects held stable after controlling for sample demographic characteristics, such as the greater perceived health in Black PLWH. CES-D remained the only statistically significant indicator of perceived health. DTS remained the strongest indicator of functional disability, followed by CES-D. HIV-related health indicators remained non-significant predictors. F-tests indicated that all models accounted for a statistically significant share of variance in the dependent variables (p's < 0.05).

DISCUSSION

This study examined the relative importance of mental health and HIV-related health indices in self-reports of health and functional impairment in a sample of HIV-positive MSM with trauma histories. We found that mental health symptoms predicted appraisals of health and functional impairment over and above biological markers of HIV disease status. Depression symptom severity accounted for the majority of variance in participants' perceptions of their health, and thus may be a primary factor shaping reports of physical health in this population. Both depression and PTSD symptom severity were influential in accounting for functional impairment. These findings support and extend previous findings that both depression and PTSD symptoms are predictors of general health perceptions, physical functioning, functioning without pain, and role functioning in HIV-positive MSM (O'Cleirigh et al., 2009).

The findings of our dominance analyses were corroborated by regression analyses that used multiple imputation and demographic covariates. The parallel findings lend increased confidence that our findings are robust to potential bias arising from missingness, statistical power limitations, or confounding variables.

Notably, across all analyses, neither HIV-related health indicator explained significant variance in participants' self-perceptions of health or functional disability. These findings suggest that symptoms of depression and PTSD may be more important than control over HIV disease processes in accounting for perceptions of health and functional disability in HIV-positive MSM with trauma histories. One explanation for this surprising finding is that depression and PTSD are themselves highly debilitating conditions; MDD is among the three leading causes of disability worldwide, and both depression and PTSD have shown well-established links with poor physical health outcomes (James et al., 2018; K. M. Keyes et al., 2013; Nichter et al., 2019; Schnurr et al., 2009). Another explanation is that many HIV symptoms are well controlled by HAART. Although participants eligible for this study were MSM with suboptimal engagement in HIV care, 81.8% reported an undetectable HIV

viral load, and 90.5% had a CD4 count greater than 200. Additionally, many participants may have been managing their HIV for decades, yet dealing with current mood problems or posttraumatic responses.

Our findings add to a sizable body of literature indicating that MSM are vulnerable to poor physical and mental health outcomes due to an increased cumulative burden of lifetime stress. The minority stress model suggests that MSM experience elevated stress due to sexual orientation stigma and discrimination, which impacts physical and mental health via numerous mechanisms, including interpersonal prejudice, expectations of rejection, sexual identity concealment, internalized homophobia, and avoidance coping (Batchelder et al., 2018; Hatzenbuehler, 2009; Martin et al., 2005; Meyer, 2003). Consistent with this framework, the current sample exhibited striking rates of psychological morbidity; 51.9% met DSM-5 criteria for current PTSD at the time of assessment and 41.8% met criteria for lifetime MDD. Alcohol use disorders (25.3%) and other substance use disorders (34.2%) were also prevalent. For HIV-positive MSM, the presence of PTSD and depression may not only exacerbate perceived health and functional impairment but may also interfere with adaptive engagement in HIV care (O'Cleirigh et al., 2009).

Black HIV-positive MSM were more likely to report multiple lifetime traumas, yet had similar rates of PTSD diagnosis and reported less severe PTSD and depression symptoms than White participants. Several explanations may account for this paradoxical finding. Black MSM experience greater rates of exposure to trauma and violence than White MSM, yet tend to have lower rates of common mental health disorders, potentially indicative of a greater amount of resiliency compared to White MSM (Bogart et al., 2017; Brewer et al., 2020; C. L. Keyes, 2009; Mustanski et al., 2019; Quinn et al., 2020). Additionally, some research suggests that Black people may be socialized to report less distress, and thus may underreport psychological symptoms (Bardwell & Dimsdale, 2001). Both explanations may indicate clinician bias in assessment. Altogether, these findings suggest more research is needed to disentangle these paradoxical trends—research particularly warranted in North America given the current sociopolitical context of disproportionate police killings of Black men and enormous racial disparities in HIV incidence (CBC News; Centers for Disease Control and Prevention, 2019; Haddad et al., 2018; Washington Post).

Our findings hold important implications for HIV clinical care. Brief assessment of mental health symptoms in HIV primary care settings will help clinicians interpret self-reports of physical impairment and global estimates of health. Given high rates of posttraumatic stress symptoms among HIV-positive MSM, a trauma-informed approach (TIA) may enhance treatment outcomes in primary care (Brezing et al., 2015). In particular, integration of case managers, health navigators, peer support models, and warm hand-offs may facilitate mental health treatment engagement in MSM already struggling to engage with the HIV care cascade. A TIA may be especially important in settings serving Black MSM, who face syndemic risk factors contributing to disproportionate HIV incidence and poor outcomes across the HIV treatment cascade (Centers for Disease Control and Prevention, 2019; Quinn et al., 2020).

Research implications of the current study include the need for longitudinal and randomized study designs to disentangle the causality of mental health problems and HRQOL in HIV-positive MSM. Should longitudinal findings confirm these results, these findings would underscore the priority for development of integrated treatments that address overlapping mental health issues and support optimal engagement in HIV care.

Limitations of the present study include possible overlap between HRQOL constructs and physical symptoms of depression and PTSD, which we aimed to reduce through use of the CES-D and DTS, which focus minimally on physical symptoms of depression and PTSD. Additionally, our findings may be influenced by a negative response bias among depressed individuals who have greater posttraumatic stress symptom burden (i.e., more distressed people may be inclined to perceive health more negatively or view themselves as more impaired).

CONCLUSIONS

The present analysis suggests that depression and PTSD may contribute to poor health perceptions and functional disability in HIV-positive MSM with trauma histories who are poorly engaged in care. These results indicate the need for a TIA to HIV treatment in primary care settings.

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REFERENCES

Azen R, & Budescu DV (2003). The dominance analysis approach for comparing predictors in multiple regression. Psychological methods, 8(2), 129. [PubMed: 12924811]

Bardwell WA, & Dimsdale JE (2001). The Impact of Ethnicity and Response Bias on the Self-Report of Negative Affect. Journal of Applied Biobehavioral Research, 6(1), 27–38.

Batchelder AW, Choi K, Dale SK, Pierre-Louis C, Sweek EW, Ironson G, Safren SA, & O'Cleirigh C (2019). Effects of syndemic psychiatric diagnoses on health indicators in men who have sex with men. Health Psychol, 38(6), 509–517. 10.1037/hea0000724 [PubMed: 30973745]

Batchelder AW, Safren SA, Coleman JN, Boroughs MS, Thiim A, Ironson GH, Shipherd JC, & O'Cleirigh C (2018). Indirect Effects From Childhood Sexual Abuse Severity to PTSD: The Role of Avoidance Coping. J Interpers Violence, 886260518801030. 10.1177/0886260518801030

Boarts JM, Sledjeski EM, Bogart LM, & Delahanty DL (2006). The differential impact of PTSD and depression on HIV disease markers and adherence to HAART in people living with HIV. AIDS and behavior, 10(3), 253–261. [PubMed: 16482405]

Bogart LM, Dale SK, Christian J, Patel K, Daffin GK, Mayer KH, & Pantalone DW (2017). Coping with discrimination among HIV-positive Black men who have sex with men. Culture, health & sexuality, 19(7), 723–737.

Bozzette SA, Hays RD, Berry SH, Kanouse DE, & Wu AW (1995). Derivation and properties of a brief health status assessment instrument for use in HIV disease. Journal of acquired immune deficiency syndromes and human retrovirology: official publication of the International Retrovirology Association, 8(3), 253–265.

Brewer R, Hood KB, Moore M, Spieldenner A, Daunis C, Mukherjee S, Smith-Davis M, Brown G, Bowen B, & Schneider JA (2020). An Exploratory Study of Resilience, HIV-Related Stigma, and HIV Care Outcomes Among Men who have Sex with Men (MSM) Living with HIV in Louisiana. AIDS and behavior, 1–11. [PubMed: 30903450]

Brezing C, Ferrara M, & Freudenreich O (2015). The syndemic illness of HIV and trauma: implications for a trauma-informed model of care. Psychosomatics, 56(2), 107–118. [PubMed: 25597836]

Budescu DV (1993). Dominance analysis: a new approach to the problem of relative importance of predictors in multiple regression. Psychological bulletin, 114(3), 542.

Bustos C, & Coutinho Soares F (2020). dominanceanalysis-package: Dominance analysis for general, generalized, and mixed linear models. R package Version 1.3.0.

CBC News. Deadly force: Fatal encounters with police in Canada: 2000-2017. CBC News. https://newsinteractives.cbc.ca/longform-custom/deadly-force

Centers for Disease Control and Prevention. (2019). CDC Fact Sheet: HIV among African Americans. Retrieved April 13, 2019 from https://www.cdc.gov/nchhstp/newsroom/docs/factsheets/cdc-hiv-aa-508.pdf

Choi KW, Batchelder AW, Ehlinger PP, Safren SA, & O'Cleirigh C (2017). Applying network analysis to psychological comorbidity and health behavior: Depression, PTSD, and sexual risk in sexual minority men with trauma histories. Journal of consulting and clinical psychology, 85(12), 1158. [PubMed: 29189032]

Chukwurah JN, Voss J, Mazanec SR, Avery A, & Webel A (2020). Associations Between Influencing Factors, Perceived Symptom Burden, and Perceived Overall Function Among Adults Living With HIV. Journal of the Association of Nurses in AIDS Care, 31(3), 325–336.

Cruess DG, Petitto JM, Leserman J, Douglas SD, Gettes DR, Ten Have TR, & Evans DL (2003). Depression and HIV infection: impact on immune function and disease progression. Cns Spectrums, 8(1), 52–58. [PubMed: 12627049]

Davidson JR, Book S, Colket J, Tupler L, Roth S, David D, Hertzberg M, Mellman T, Beckham J, & Smith R (1997). Assessment of a new self-rating scale for post-traumatic stress disorder. Psychological medicine, 27(1), 153–160. [PubMed: 9122295]

Duncan RD, Saunders BE, Kilpatrick DG, Hanson RF, & Resnick HS (1996). Childhood physical assault as a risk factor for PTSD, depression, and substance abuse: Findings from a national survey. American Journal of Orthopsychiatry, 66(3), 437–448. [PubMed: 8827267]

Fazeli PL, Turan JM, Budhwani H, Smith W, Raper JL, Mugavero MJ, & Turan B (2017). Moment-to-moment within-person associations between acts of discrimination and internalized stigma in people living with HIV: An experience sampling study. Stigma and Health, 2(3), 216. [PubMed: 28966982]

Gill CJ, Griffith JL, Jacobson D, Skinner S, Gorbach SL, & Wilson IB (2002). Relationship of HIV viral loads, CD4 counts, and HAART use to health-related quality of life. Journal of acquired immune deficiency syndromes (1999), 30(5), 485–492. [PubMed: 12154339]

Glynn TR, Llabre MM, Lee JS, Bedoya CA, Pinkston MM, O'Cleirigh C, & Safren SA (2019). Pathways to health: An examination of HIV-related stigma, life stressors, depression, and substance use. International journal of behavioral medicine, 26(3), 286–296. [PubMed: 31065930]

Haddad N, Li J, Totten S, & McGuire M (2018). Adult immunization: HIV in Canada—Surveillance Report, 2017. Canada Communicable Disease Report, 44(12), 324. [PubMed: 31517950]

Harel O (2009). The estimation of R 2 and adjusted R 2 in incomplete data sets using multiple imputation. Journal of Applied Statistics, 36(10), 1109–1118.

Hatzenbuehler ML (2009). How does sexual minority stigma "get under the skin"? A psychological mediation framework. Psychological bulletin, 135(5), 707. [PubMed: 19702379]

Hatzenbuehler ML, & Pachankis JE (2016). Stigma and minority stress as social determinants of health among lesbian, gay, bisexual, and transgender youth: research evidence and clinical implications. Pediatric Clinics, 63(6), 985–997. [PubMed: 27865340]

Jacobson DL, Wu AW, & Feinberg J (2003). Health-related quality of life predicts survival, cytomegalovirus disease, and study retention in clinical trial participants with advanced HIV disease. Journal of clinical epidemiology, 56(9), 874–879. [PubMed: 14505773]

James SL, Abate D, Abate KH, Abay SM, Abbafati C, Abbasi N, Abbastabar H, Abd-Allah F, Abdela J, & Abdelalim A (2018). Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. The Lancet, 392(10159), 1789–1858.

Kessler RC, Sonnega A, Bromet E, Hughes M, & Nelson CB (1995). Posttraumatic stress disorder in the National Comorbidity Survey. Archives of general psychiatry, 52(12), 1048–1060. [PubMed: 7492257]

Keyes CL (2009). The Black–White paradox in health: Flourishing in the face of social inequality and discrimination. Journal of personality, 77(6), 1677–1706. [PubMed: 19796064]

Keyes KM, McLaughlin KA, Demmer RT, Cerdá M, Koenen KC, Uddin M, & Galea S (2013). Potentially traumatic events and the risk of six physical health conditions in a population-based sample. Depression and anxiety, 30(5), 451–460. [PubMed: 23495094]

Kilpatrick DG, Ruggiero KJ, Acierno R, Saunders BE, Resnick HS, & Best CL (2003). Violence and risk of PTSD, major depression, substance abuse/dependence, and comorbidity: results from the National Survey of Adolescents. Journal of consulting and clinical psychology, 71(4), 692. [PubMed: 12924674]

Lenderking WR, Wold C, Mayer KH, Goldstein R, Losina E, & Seage GR (1997). Childhood sexual abuse among homosexual men: Prevalence and association with unsafe sex. Journal of general internal medicine, 12(4), 250–253. [PubMed: 9127231]

Little RJA, & Rubin DB (2014). Statistical analysis with missing data (Vol. 333). John Wiley & Sons.

Lloyd S, & Operario D (2012). HIV risk among men who have sex with men who have experienced childhood sexual abuse: systematic review and meta-analysis. AIDS Education and Prevention, 24(3), 228–241. [PubMed: 22676462]

Lorenz KA, Cunningham WE, Spritzer KL, & Hays RD (2006). Changes in symptoms and health-related quality of life in a nationally representative sample of adults in treatment for HIV. Quality of Life Research, 15(6), 951–958. [PubMed: 16900276]

Martin JI, Pryce JG, & Leeper JD (2005). Avoidance coping and HIV risk behavior among gay men. Health & social work, 30(3), 193. [PubMed: 16190295]

Mathews WC, & May S (2007). EuroQol (EQ-5D) measure of quality of life predicts mortality, emergency department utilization, and hospital discharge rates in HIV-infected adults under care. Health and Quality of Life Outcomes, 5(1), 5. [PubMed: 17254361]

Meyer IH (2003). Prejudice, social stress, and mental health in lesbian, gay, and bisexual populations: conceptual issues and research evidence. Psychological bulletin, 129(5), 674. [PubMed: 12956539]

Milanini B, Catella S, Perkovich B, Esmaeili-Firidouni P, Wendelken L, Paul R, Greene M, Ketelle R, & Valcour V (2017). Psychiatric symptom burden in older people living with HIV with and without cognitive impairment: the UCSF HIV over 60 cohort study. AIDS Care, 29(9), 1178–1185. [PubMed: 28127989]

Mimiaga MJ, Noonan E, Donnell D, Safren SA, Koenen KC, Gortmaker S, O'Cleirigh C, Chesney MA, Coates TJ, & Koblin BA (2009). Childhood sexual abuse is highly associated with HIV risk–taking behavior and infection among MSM in the EXPLORE study. Journal of acquired immune deficiency syndromes (1999), 51(3), 340. [PubMed: 19367173]

Mugavero MJ, Amico KR, Horn T, & Thompson MA (2013). The state of engagement in HIV care in the United States: from cascade to continuum to control. Clinical Infectious Diseases, 57(8), 1164–1171. [PubMed: 23797289]

Mustanski B, Morgan E, D'Aquila R, Birkett M, Janulis P, & Newcomb ME (2019). Individual and network factors associated with racial disparities in HIV among young men who have sex with

men: Results from the RADAR cohort study. Journal of acquired immune deficiency syndromes (1999), 80(1), 24. [PubMed: 30365451]

Nichter B, Norman S, Haller M, & Pietrzak RH (2019). Physical health burden of PTSD, depression, and their comorbidity in the US veteran population: Morbidity, functioning, and disability. Journal of psychosomatic research, 124, 109744. [PubMed: 31443821]

Noor SW, Sutherland JE, Vernon JR, Adam BD, Brennan DJ, & Hart TA (2020). Measuring Adverse Childhood Experiences: Comparing Individual, Composite, Score-based and Latent Profile-based Scoring Schemas Among Gay, Bisexual, and Other Men Who Have Sex with Men. Archives of Sexual Behavior.

O'Cleirigh C, Ironson G, Antoni M, Fletcher MA, McGuffey L, Balbin E, Schneiderman N, & Solomon G (2003). Emotional expression and depth processing of trauma and their relation to long-term survival in patients with HIV/AIDS. Journal of psychosomatic research, 54(3), 225–235. [PubMed: 12614832]

O'Cleirigh C, Skeer M, Mayer KH, & Safren SA (2009). Functional impairment and health care utilization among HIV-infected men who have sex with men: the relationship with depression and post-traumatic stress. Journal of Behavioral Medicine, 32(5), 466–477. [PubMed: 19526337]

Pachankis JE (2007). The psychological implications of concealing a stigma: A cognitive-affective-behavioral model. Psychological bulletin, 133(2), 328. [PubMed: 17338603]

Pantalone DW, Horvath KJ, Hart TA, Valentine SE, & Kaysen DL (2015). Traumatic revictimization of men who have sex with men living with HIV/AIDS. Journal of interpersonal violence, 30(9), 1459–1477. [PubMed: 24989040]

Quinn KG, Spector A, Takahashi L, & Voisin DR (2020). Conceptualizing the effects of continuous traumatic violence on HIV continuum of care outcomes for young Black men who have sex with men in the United States. AIDS and behavior, 1–15. [PubMed: 30903450]

Radloff LS (1977). The CES-D scale: A self-report depression scale for research in the general population. Applied psychological measurement, 1(3), 385.

Rubin D (1987). Multiple Imputation for Nonresponse in Surveys. New York: John Wiley & Sons Inc.

Rytwinski NK, Scur MD, Feeny NC, & Youngstrom EA (2013). The co-occurrence of major depressive disorder among individuals with posttraumatic stress disorder: A meta-analysis. Journal of traumatic stress, 26(3), 299–309. [PubMed: 23696449]

Schnurr PP, Lunney CA, Bovin MJ, & Marx BP (2009). Posttraumatic stress disorder and quality of life: Extension of findings to veterans of the wars in Iraq and Afghanistan. Clinical psychology review, 29(8), 727–735. [PubMed: 19744758]

Teeraananchai S, Kerr S, Amin J, Ruxrungtham K, & Law M (2017). Life expectancy of HIV-positive people after starting combination antiretroviral therapy: a meta-analysis. HIV medicine, 18(4), 256–266. [PubMed: 27578404]

Thompson MA, Horberg MA, Agwu AL, Colasanti JA, Jain MK, Short WR, Singh T, & Aberg JA (2020). Primary Care Guidance for Persons With Human Immunodeficiency Virus: 2020 Update by the HIV Medicine Association of the Infectious Diseases Society of America. Clinical Infectious Diseases. 10.1093/cid/ciaa1391

Üstün TB, Kostanjsek N, Chatterji S, & Rehm J (2010). Measuring health and disability: Manual for WHO disability assessment schedule WHODAS 2.0. World Health Organization.

van Buuren S, & Groothuis-Oudshoorn K (2010). mice: Multivariate imputation by chained equations in R. Journal of statistical software, 1–68.

Viswanathan S, Detels R, Mehta SH, Macatangay BJ, Kirk GD, & Jacobson LP (2015). Level of adherence and HIV RNA suppression in the current era of highly active antiretroviral therapy (HAART). AIDS and behavior, 19(4), 601–611. [PubMed: 25342151]

Washington Post. Shot dead by police. The Washington Post. https://www.washingtonpost.com/graphics/national/police-shootings/.

Table 1:

Participant demographic and health characteristics with comparisons among racial and ethnic identity subgroups

	Mean (SD) or number (%)				
Characteristic	**Total Sample (N=79)**	**White (N=39)**	**Black/ African American/ Black Canadian (N=28)**	**Other or unknown racial identity (N=12)**	**Ethnicity: Hispanic/ Latinx (N=6)**
Demographic characteristics					
Age (years)	48.6 (9.4)	47.0 (9.2)	53.0 (7.9) **	46.8 (8.6)	49.5 (7.1)
Education					
Less than HS degree	8 (10.1%)	4 (10.3%)	2 (7.1%)	2 (16.7)	1 (16.7%)
HS degree	20 (25.3%)	10 (25.6%)	9 (32.1%)	2 (16.7)	1 (16.7)
Some College	25 (31.6%)	14 (35.9%)	8 (28.6%)	4 (33.3)	4 (66.7%)
College Degree or more	23 (29.1%)	11 (28.2%)	9 (10.7%)	4 (33.3)	0 (0%)
Annual income[a]					
Less than $10,000	26 (32.9%)	11 (28.2%)	14 (50%)	4 (33.3%)	3 (50%)
$10,000 to $20,000	39 (49.4%)	20 (51.3%)	12 (42.9%)	7 (58.3%)	3 (50%)
$20,000 to $40,000	10 (12.7%)	7 (17.9%)	2 (7.1%)	1 (8.3%)	0 (0%)
$40,000 to $60,000	1 (1.3%)	1 (2.6%)	0 (0%)	0 (0%)	0 (0%)
HIV-related and general health characteristics					
CD4 count (cells/mm^3)					
< 200	4 (9.5%)	2 (9.1%)	0 (0%)	2 (25%)	0 (0%)
200-799	25 (59.5%)	15 (68.2%)	9 (64.3%)	2 (25%)	0 (0%)
≥ 800	13 (31%)	5 (22.7%)	5 (35.7%)	4 (50%)	2 (100%)
Viral Load (mean plasma HIV RNA: copies/ml)	14,230.9 (55,259.27)	11,914.7 (39,034.7)	3,644.5 (13,543.7)	42,479.8 (111,692.4)	60,666.7 (105,077.7)
Viral Load (self-reported)					
Undetectable	45 (81.8%)	22 (78.6%)	18 (85.7%)	6 (85.7%)	4 (80%)
Detectable	10 (18.2%)	6 (21.4%)	3 (14.3%)	1 (14.3%)	1 (20%)
Perceived Physical Health (0-100 VAS)	63.3 (20.6)	60.2 (21.0)	70.3 (18.1) *	64.4 (12.1)	64.2 (10.2)
Functional Disability Score (WHO DAS 2.0)	8.7 (8.9)	9.9 (8.3)	7.6 (9.9)	3.4 (2.6) ***	7.2 (4.2)
Trauma history and mental health characteristics					
Current PTSD diagnosis	41 (51.9%)	25 (64.1%)	17 (60.7%)	5 (41.7%)	2 (33.3%)
Multiple (2 or more) PTSD Criterion A traumas endorsed	52 (65.9)	23 (59)	23 (82.1) *	8 (66.7)	5 (83.4)
Index trauma type					
Sexual assault or rape	21 (26.6)	7 (17.9) *	10 (35.7)	4 (33.3)	1 (16.7)
Physical violence	16 (20.3)	7 (17.9)	9 (32.1)	2 (16.7)	1 (16.7)
Discrimination/Stigma	12 (15.2)	10 (25.6)	1 (3.6)	1 (8.3)	2 (33.3)

	Mean (SD) or number (%)				
Characteristic	**Total Sample (N=79)**	**White (N=39)**	**Black/ African American/ Black Canadian (N=28)**	**Other or unknown racial identity (N=12)**	**Ethnicity: Hispanic/ Latinx (N=6)**
Witnessed or heard about violence or death	7 (8.9)	3 (7.7)	2 (7.1)	2 (16.7)	0 (0)
Other	23 (29.1)	12 (30.7)	6 (21.4)	3 (25)	2 (33.3)
PTSD symptom score (DTS)	46.1 (26.6)	53.1 (24.5) *	39.8 (28.8)	37.0 (23.5)	42.2 (22.8)
Sexual abuse before age 13	31 (41.9%)	20 (51.3%)	10 (37%)	2 (16.7%)	4 (66.7%)
Adolescent sexual abuse	22 (29.7%)	11 (28.2%)	9 (33.3%)	1 (8.3%)	2 (33.3%)
Childhood or adolescent sexual abuse	40 (50.6%)	23 (59%)	14 (50%)	3 (25%)	4 (66.7%)
Physical abuse before age 17	45 (60.8%)	27 (69.2%)	12 (44.4%) *	6 (50%)	4 (66.7%)
Intimate Partner Violence	50 (67.6%)	30 (76.9%)	15 (55.6%)	6 (50%)	5 (80%)
Sexual assault during adulthood	34 (45.9%)	18 (46.2%)	12 (44.4%)	4 (33.3%)	1 (16.7%)
Lifetime MDD diagnosis	33 (41.8%)	20 (51.3%)	10 (35.7%)	3 (25%)	1 (20%)
Depression Symptom Score (CES-D)	27.5 (11.4)	30.9 (10.5) **	24.8 (11.5)	20.9 (11.2) *	24.8 (10.8)
Current Alcohol Use Disorder	20 (25.3%)	10 (25.6%)	8 (28.6%)	3 (25%)	4 (66.7%) *
Other current substance use disorder	27 (34.2%)	16 (41%)	9 (32.1%)	3 (25%)	4 (66.7%)

PTSD = Post-Traumatic Stress Disorder; DTS = Davidson Trauma Scale frequency + severity total score (0-XX; higher score indicates greater impairment); CES-D = Center for Epidemiological Studies Depression Scale (0-XX; higher score indicates greater severity of depression symptoms); WHO DAS = World Health Organization Disability Assessment Schedule 2.0; VAS = Visual analog scale

[a] Income was reported in either US or Canadian dollars as per the location of each participant.

p-values denote results of *t*-tests and χ^2 analyses comparing each racial or ethnic subgroup against all other participants.

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$

Percentages denote percent of valid values (excluding missing data).

Table 2:

Dominance analysis for HIV-related and mental health correlates of perceived health and functional disability

A: Health Perception

	CES-D	Davidson	Viral Load	Total R^2
GD Weight (%)	0.177* (69.9%)	0.040 (15.8%)	0.036 (14.2%)	0.253
95% CI	(0.038, 0.316)	(−0.043, 0.115)	(−0.075, −0.155)	

B: Health Perception

	CES-D	Davidson	CD4 Count	R^2
GD Weight (%)	0.204* (91.5%)	0.018 (8.1%)	0.001 (0.4%)	.223
95% CI	(0.056, 0.352)	(−0.064, 0.099)	(−0.108, 0.110)	

C: Functional Disability

	CES-D	Davidson	Viral Load	R^2
GD Weight (%)	0.119 (38.6%)	0.170* (55.2%)	0.019 (6.2%)	.308
95% CI	(−0.017, 0.254)	(0.044, 0.296)	(−0.036, 0.072)	

D: Functional Disability

	CES-D	Davidson	CD4 Count	R^2
GD Weight (%)	0.165* (42.5%)	0.173* (44.6%)	0.050 (12.9%)	.388
95% CI	(0.046, 0.284)	(0.034, 0.312)	(−0.059, 0.158)	

GD weight = general dominance weight; 95% CI = 95% confidence intervals. % = the proportion of R^2 accounted for. This proportion is derived from the ratio of the general dominance weight to the total R^2.

* $p < 0.05$.

Models A and C examine CES-D and DTS relative to HIV RNA viral suppression status, whereas models B and D examine these psychological symptom measures in relation to CD4 count.

Table 3:

Linear regression analyses examining the relationship between HIV-related (viral load, CD4 count) and mental health (post-traumatic stress and depression symptom severity) indicators with two health-related quality of life outcomes: perceived general health and functional disability

Health Perception					
	β: Step 1	**β: Step 2 (Model A)**	**β: Step 3 (Model A)**	**β: Step 2 (Model B)**	**β: Step 3 (Model B)**
Age	0.144	0.132	0.033	0.142	0.031
Education	0.139	0.133	0.129	0.155	0.126
Race					
White	0.129	0.131	0.301	0.089	0.312
Black	0.315	0.317	0.392 *	0.269	0.413 *
Native/Indigenous North American	0.068	0.072	−0.034	0.076	−0.045
Hispanic/Latinx ethnicity	0.001	0.010	−0.021	−0.027	−0.017
HIV Viral Suppression Status		−0.078	−0.071		
CD4 count (cells/mm^3)				0.106	−0.053
Depression symptoms (CES-D)			−0.451 **		−0.465 **
PTSD symptoms (DTS)			−0.062		−0.065
F	1.845	1.603	3.263 *	1.680	3.335 *
df	72	71	69	71	69
R^2	0.138	0.147	0.334	0.158	0.328
ΔR	0.138	0.009	0.187 **	0.020	0.170 *
Functional Disability					
	β: Step 1	**β: Step 2 (Model C)**	**β: Step 3 (Model C)**	**β: Step 2 (Model D)**	**β: Step 3 (Model D)**
Age	−0.090	−0.094	−0.091	−0.091	−0.077
Education	−0.013	−0.014	−0.080	−0.027	−0.069
Race					
White	0.177	0.179	−0.026	0.210	−0.012
Black	0.087	0.089	0.084	0.126	0.041
Native/Indigenous North American	−0.041	−0.039	0.065	−0.047	0.080
Hispanic/Latinx ethnicity	0.036	0.040	0.065	0.060	0.038
HIV Viral Suppression Status		−0.023	−0.015		
CD4 count (cells/mm^3)				−0.083	0.101
Depression symptoms (CES-D)			0.252		0.275 *
PTSD symptoms (DTS)			0.385 **		0.402 **
F	0.224	0.193	3.093 *	0.167	3.229 *
df	72	71	69	71	69
R^2	0.040	0.043	0.297	0.050	0.308

Health Perception					
	β: Step 1	**β: Step 2 (Model A)**	**β: Step 3 (Model A)**	**β: Step 2 (Model B)**	**β: Step 3 (Model B)**
ΔR^2	0.040	0.003	0.254 **	0.258	0.268 *

* p < 0.05.

** p < 0.01.