NORTHWESTERN UNIVERSITY

Positive Psychological Constructs and Physiological Outcomes
in the Women's Interagency HIV Study

A DISSERTATION

SUBMITTED TO THE GRADUATE SCHOOL
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

for the degree

DOCTOR OF PHILOSOPHY

Field of Health Sciences Integrated Program

By

Sarah M. Bassett

EVANSTON, ILLINOIS

September 2019

Abstract

Women living with human immunodeficiency virus (WLWH) have unique health challenges. Understanding psychological strengths that help WLWH manage their disease and improve health outcomes could reduce disease burden. Although spirituality, a multidimensional construct that includes a search for meaning and purpose, connection with a higher dimension, and experiences and feelings associated with said search and connection, and positive affect, defined as positively valenced feelings (e.g., happy, calm, thrilled), have both been associated with better outcomes in HIV, the pathways and predictive abilities of these constructs on physical and psychological health must be elucidated for researchers and clinicians to best support WLWH in achieving and maintaining optimal health. Additionally, it is crucial to understand the acceptability of learning positive affect skills among WLWH. The current work explores the predictive abilities of spirituality and positive affect, and ascertains whether WLWH find learning positive affect skills to be acceptable. First, we examined whether spirituality among WLWH participants is associated with viral load one year later, and whether this relationship is mediated by positive affect or self-reported antiretroviral therapy adherence at six months. Next, we examine whether spirituality or positive affect independently predicts different biomarkers and quality of life among WLWH and demographically similar women. Finally, we tailor a program intended to increase positive affect in people living with HIV to be acceptable and feasible for WLWH and conduct a proof of concept study in this population. Taken together, the current studies provide a clearer view of whether spirituality and positive affect predict physical and health outcomes in HIV, and provide preliminary insight into the acceptability of a positive affect skills program for WLWH.

Acknowledgements

Table of Contents

List of Tables and Figures

Introduction

Prevalence of HIV and difficulty of viral load suppression. During 2015, 7,400
women in the United States were diagnosed with HIV, and during that same year, only 51% of
women living with HIV (WLWH) were retained in continuous HIV care or achieved a
suppressed viral load.[1,2] In 2016, the number of women diagnosed with HIV increased to 7,528,
and an additional 7,401 women were diagnosed with HIV in 2017.[2] During this same year, adult
and adolescent women comprised fully 19% of newly diagnosed HIV cases.[1] For all people
living with HIV (PLWH), including WLWH, to become and remain virally suppressed, they
must first get tested for HIV, linked to HIV-specific healthcare providers, and begin
antiretroviral treatment.[3] Subsequently, they must maintain medication adherence such that they
achieve continual viral load suppression.[4-6]

However, WLWH are a vulnerable population, and are underrepresented in studies of
engagement in care.[7] In one study with WLWH, 61% of participants reported gender-based
violence exposure, and the estimated rate of intimate partner violence among WLWH is
55.3%.[8,9] Among WLWH, intimate partner violence is associated with a CD4+ count of <200,
but not markers of adherence to antiretroviral medications including viral suppression and
missed visits, suggesting that intimate partner violence and trauma may alter immune
functioning in WLWH.[10] Biological and transgender WLWH who report recent trauma have
four times greater odds of antiretroviral failure independent of adherence as compared with
women who have not experienced recent trauma.[11] In addition, WLWH are more likely to suffer
a lack of economic and educational opportunities and a history of racial and gender
discrimination than HIV- women.[12-14] Among Women's Interagency HIV Study (WIHS)
participants, WLWH experience stigma in health care settings, which is associated with

suboptimal medication adherence.[15] WLWH also tend to engage in self-silencing, or not stating their needs in order to maintain harmony.[16] Self-silencing among WLWH has been associated with a lower likelihood of engaging in safe-sex behavior[17] and a lower likelihood of achieving ≥95% antiretroviral therapy (ART) adherence over six months.[18] As compared to HIV- women, they are at increased risk of myocardial infarction, osteoporosis, cervical cancer, and birth control failure.[19] They are also at greater risk for liver and pancreas problems resulting from the use of HIV medication than are men.[19] Given women's vulnerability, studying ways to help WLWH achieve optimal psychological and physical health is crucial.

Spirituality in HIV. Negative emotional states such as stress and depression are common in PLWH and present barriers to engaging in beneficial health behaviors and outcomes, such as adhering to antiretroviral therapy (ART).[6,20] However, there is promising evidence suggesting that positive constructs, such as spirituality, are related to better outcomes in PLWH.[21] Spirituality, defined as a multidimensional construct that includes a search for meaning and purpose, connection with a higher dimension, and experiences and feelings associated with said search and connection,[21] often increases after HIV diagnosis and is commonly used to cope with the stress of living with HIV.[22] It has also been associated with slower HIV disease progression and longer survival.[23,24] Interestingly, Kremer et al.,[25] found that using spirituality to cope with stress in HIV is related to lower viral loads, and among HIV+ samples, those who show an increase in spirituality post-diagnosis maintain lower viral loads.[23] Use of spirituality is prevalent among WLWH and PWLH in general. For example, one study examining the use of spirituality among African American WLWH found that 80% of participants prayed once a day or nearly every day, and 40% meditated at least once a week.[26] In this same study, 95% of participants said that spiritual beliefs were very or extremely important to them, underscoring the

importance of spirituality among WLWH.[26] Among WIHS participants, research has suggested

that loving kindness meditation may be a useful component of managing HIV care.[27] Similarly, a

component of mindfulness, acting with awareness, has been negatively correlated with PTSD

among PLWH.[28] Among others, there are two promising pathways through which spirituality

might predict viral load: through positive affect and through increased ART adherence.

Positive affect. Positive affect, defined as positively valenced feelings (e.g., happy, calm,

thrilled),[29] has been shown to be uniquely associated with increased engagement in care,

reduced likelihood of mortality, and increased likelihood of viral suppression.[30-32] Within the

WIHS cohort, Wilson and colleagues[32] found a direct, inverse relationship between positive

affect and viral load, independent of negative affect. In addition, spirituality is related to benefit

finding and positive reappraisal coping in PLWH,[31] indicating that spirituality may be related to

coping strategies associated with increased positive affect.[29]

However, few studies have looked at both spirituality and positive affect in relation to

viral load, and to our knowledge, none in samples of women, impeding our understanding of

what psychological constructs are most strongly predictive of this crucial HIV-related health

outcome in women. While previous research suggests relationships between positive

psychological constructs and health among PLWH, we do not know whether positive affect

mediates the relationship between spirituality and viral load.

ART adherence. In order to achieve beneficial health outcomes such as a suppressed viral

load, PLWH must engage with the healthcare system to obtain ART, and must adhere to their

ART regimens.[3] Interestingly, greater positive affect at the time of HIV diagnosis has been

associated with higher odds of engagement in care 3 months later and with higher likelihood of

remaining on ART in PLWH,[33] underscoring the importance of examining whether other positive psychological constructs, like spirituality, also increase likelihood of ART use.

Examining whether the relationships between spirituality and viral load are mediated by ART adherence or positive affect could spur the development of interventions that help women capitalize upon their current levels of spirituality or increase their levels of positive affect, so that they may potentially cope with the stress of HIV more easily and, ultimately, improve their psychological and physical health.

Relationships of spirituality and positive affect with healthier immune markers, stress markers, and QOL in HIV. Higher levels of cortisol, a biomarker associated with stress, are associated with faster progression to AIDS and mortality.[34] As such, exploring the association between psychological constructs and cortisol in HIV is essential. Research conducted with a 75% male sample of PLWH indicates that spirituality is negatively related to overnight urinary cortisol levels.[24] The finding that positive psychological constructs are negatively associated with cortisol has also been seen in women. Among healthy women in the Whitehall II cohort, cortisol levels were negatively associated with positive affect.[35] Previous research has also indicated that spirituality and positive resources may be linked in their association with cortisol. Specifically, spirituality is related to benefit finding and positive reappraisal coping, and benefit finding is related to lower 24-hour urinary cortisol in PLWH.[31] Optimism, a positive psychological factor, and cortisol have both been associated with decreased mortality in a mixed-gender sample of PLWH,[24] but there is less information in the direct relationship between positive psychological factors and cortisol in WLWH.

Proinflammatory cytokines and markers of inflammation that have been associated with poor health outcomes in HIV have been shown to be inversely related to positive psychological

factors. For example, tumor necrosis factor receptor II (TNFRII), a receptor for the proinflammatory cytokine tumor necrosis factor-α (TNF-α), activates immunosuppression and has been implicated in the promotion of cervical cancer, for which WLWH are already at higher risk than women living without HIV.[36,37] TNFRII may have a role in T cell apoptosis occurring in pathogenesis of HIV,[38] and elevated levels of TNFRII are associated with HIV disease progression[39] and a higher probability of non-AIDS-defining events.[40]

Elevated levels of C-reactive protein (CRP), an inflammatory marker that increases in chronic inflammatory conditions, have been associated with progression to AIDS,[41] and with mortality[41,42] among WLWH. In addition, HIV patients with elevated CRP levels have been shown to have over a four times higher risk of myocardial infarction than their HIV- counterparts with normal levels of CRP.[43]

Aspects of spirituality such as negative religious coping (e.g., spiritual discontent, demonic reappraisal) are associated with higher interleukin-6 (IL-6), a marker of inflammation, preoperatively in cardiac patients in an in-patient hospital setting during a time of high health-related stress.[44] Higher IL-6 levels are associated with higher HIV viral loads,[45] and as IL-6 is responsive to psychological factors such as emotion as well as religious coping style, it is plausible that IL-6 is responsive to spirituality and positive affect. In people who do not have HIV, IL-6 is inversely associated with positive affect.[35,46] IL-6 also appears susceptible to emotional states within the context of HIV. Specifically, psychological stress, as measured by the Perceived Stress Scale[47] is correlated with higher IL-6 levels in PLWH.[48]

Importantly, among patients living with chronic heart failure, another health-related chronic stressor, positive affect dimensions of a number of different scales (The Global Mood

Scale, Positive and Negative Affect Schedule, Hospital Anxiety and Depression Scale) have been associated with lower levels of TNFRII, IL-6, and CRP.[49]

Separate from biomarkers, higher QOL has been associated with lower mortality among PLWH,[50] highlighting the importance of researching predictors of QOL in this population. A meta-analysis of 62 effect sizes over 51 studies investigating the relationship between spirituality and QOL found that spirituality and QOL are positively correlated, with a moderate effect size of $r = 0.34$.[51] Qualitative data has indicated that spirituality is an important component of QOL among PLWH.[52]

As with our lack of understanding of the mediational pathways between spirituality and viral load, our lack of understanding regarding the relationships between spirituality and cortisol, proinflammatory cytokines, and QOL slows the development of evidence-based interventions. Indeed, it is crucial to test whether spirituality is independently related to proinflammatory cytokines, cortisol, or QOL, or whether these biomarkers and psychological outcomes are more strongly related to positive affect, so that researchers and clinicians can better understand potential targets for positive affect interventions or programs that may help women take advantage of using their current levels of spirituality to cope with stress.

Positive affect interventions. As positive psychological constructs, such as positive affect and spirituality, are associated with better outcomes in HIV including increased engagement in care, reduced likelihood of mortality, and increased likelihood of viral suppression,[24,30-32] researchers have begun testing multi-component interventions intended to increase positive affect in people living with HIV.[29] In a large randomized trial of a positive affect intervention on a mostly male (91.7%) sample of people recently diagnosed with HIV, participants learned a number of skills shown to increase positive affect: noticing and

capitalizing on positive events,[53-55] gratitude,[56-58] mindfulness,[59] positive reappraisal,[60,61] focusing on personal strengths,[62] achieving attainable goals,[63,64] and engaging in Altruistic Behaviors or Acts of Kindness.[65,66] Researchers found that at ten months after the end of the intervention, participants in the intervention group reported higher past-day positive affect, reductions in intrusive and avoidant thoughts about HIV, and a lower likelihood of being on antidepressants as compared to participants in the control group.[29]

While this multicomponent positive affect intervention has been tested in mostly-male samples of PLWH in a one-on-one format, it is important to tailor this intervention for WLWH, as women have unique needs.

Theoretical framework

The current research is based on two psychological theories: revised Stress and Coping Theory,[60] and the Broaden and Build Theory of positive emotion.[67]

Revised Stress and Coping Theory. According to revised Stress and Coping Theory, when people are faced with a situation they perceive as stressful, they can also experience positive psychological states which occur via three different pathways within the coping process.[60] On the first pathway, people use meaning-based processes to cope with the initial stressor. These meaning-based processes include, but are not limited to, engaging with spiritual beliefs. Secondly, when people are coping with the distress that the stressful situation is causing, meaning-based coping practices, including engaging with spiritual beliefs, can lead to increased positive emotion, which serves as a respite from the negative emotions they are experiencing. Lastly, the positive states can lead to renewed motivation to re-engage with a stressor, and can incite goal-oriented behavior.[60] See Figure 0-1 for a visual representation of this theoretical framework.

Broaden and Build Theory. According to the Broaden and Build Theory, in contrast to the narrowing of attention and inclination to fight or flee prompted by negative emotions, when one experiences positive emotional states, his or her repertoire of thoughts and potential actions is broadened, building psychological and social resources which may help individuals engage in more effective coping during stressful situations.[67] For example, a broadened mindset coupled with increased social resources may help one who would otherwise be unable to attend HIV-related appointments to find ways of creating time for this. See Figure 0-2 for a visual representation of this theoretical framework.

The current studies

The present set of studies aim to address the gap in the literature regarding the predictive abilities of spirituality and positive affect by illuminating whether spirituality predicts viral load, immune function, and hypothalamus-pituitary-adrenal (HPA) axis activity, either via or independent of positive affect, among women in the Women's Interagency HIV Study (WIHS). They also aim to examine the preliminary acceptability and feasibility of a program intended to increase positive affect specifically among WLWH.

Study 1: In study 1, we examine whether spirituality was related to viral load among WHLIV participating in WIHS. Furthermore, we examine whether ART adherence and positive affect mediate this relationship. We hypothesized that spirituality is related to lower viral load, and that positive affect and ART adherence mediate this relationship.

Study 2: In study 2, we examine whether spirituality and/or positive affect are independently related to proinflammatory cytokines and immune markers including TNFRII,

IL-6, CRP, cortisol, as well as QOL in women with and without HIV. Our hypothesis was that spirituality predicted stress- and immune-related biomarkers and QOL independently of positive affect.

Study 3: In study 3, we assess preliminary acceptability and feasibility of a positive affect skills program for WLWH. We test the acceptability and feasibility of conducting a positive affect program for a group of WIHS participants and explore the extent to which spirituality plays a role in acceptability of the program content. Our objectives were to understand whether this program was both feasible and acceptable, optimal timing of the program was with regard to proximity to HIV diagnosis, whether we should add or remove certain skills, and understand other helpful modifications.

Answers derived from these studies have significant public health implications, as results may advance our understanding of whether spirituality and positive affect can be harnessed as targets for psychological interventions, potentially improving physical and psychological health for WLWH.

Significance

While research indicates that spirituality and positive affect are related to important healthcare behaviors and outcomes in HIV, there is little information on whether spirituality predicts physical and psychological health outcomes or biomarkers independent of positive affect. Documenting predictors of better physiological outcomes is essential to create programs and policies for improving health outcomes critical to slowing the progression of HIV. Moreover, examining whether spirituality or positive affect predict physiological outcomes in WLWH could spur the development of interventions that help women capitalize on their current levels of spirituality and help them increase levels of positive affect.

Innovation

      1. Testing the relationship between spirituality and viral load. While there are indications that spirituality might influence HIV-related biomarkers,[23,25,31] it is not yet clear whether spirituality predicts viral load. The current study provides novel information regarding whether spiritually predicts viral load directly, and whether positive affect and health behaviors mediate the relationship between spirituality and viral load in WLWH. Results from these studies advance the state of knowledge regarding psychological predictors of viral load, potentially allowing for more advanced evidence-based intervention development for WLWH by helping women capitalize upon their current levels of spirituality.

      2. Spirituality as a unique predictor of HIV-related biomarkers in women. Few studies have looked at both spirituality and positive affect in relation to viral load, and to our knowledge, none in samples of WLWH, impeding our understanding of what psychological constructs are most strongly predictive of these crucial HIV-related health outcomes in this population that has biologically unique challenges associated with HIV infection.[19] The current study provides novel knowledge about the relationship between spirituality and TNFRII, IL-6, CRP, and cortisol, biomarkers that hasten the development of conditions secondary to HIV and mortality.[34,45,68] Moreover, we test whether spirituality predicts these biomarkers independently from positive affect. This furthers knowledge regarding whether biomarkers that are known to hasten mortality in HIV change are predicted by psychological resources that are potential targets of intervention.

      3. Testing acceptability and feasibility of a positive affect program for WLWH. We tailor a multicomponent positive affect intervention previously employed in mixed-gender samples of people living with HIV, testing feasibility and acceptability of a group program

intended to increase self-advocacy, self-care, and self-compassion, in addition to positive affect, among WLWH. Results from this study inform intervention development for a group with unique health risks, supporting further development of an intervention of potentially great benefit.

Approach and Methodology

Dataset and participant characteristics. Aims 1 and 2 are secondary data analyses in the Women's Interagency HIV Study (WIHS). The WIHS is an observational prospective cohort study of both WLWH and demographically similar HIV-negative women with the first recruitment wave beginning in 1994.[69,70] There have been three subsequent waves of enrollment: from 2001-2002, 2011-2012, and 2013-2015.[70] Participants attend biannual visits in which they engage in a structured interview in which they provide sociodemographic, psychological, and medical information, obstetric/gynecological and contraceptive history, and report health behaviors such as alcohol, tobacco, and other drug use and sexual behaviors. Participants also undergo a physical and gynecological examination, and provide plasma, serum, cells, cervical vaginal lavage, urine, and colon biopsy tissue samples.[71] In addition, members of the WIHS Chicago cohort participated in a cross-sectional psychoneuroimmunological (PNI) substudy, in which additional physiological and hormonal data were collected, with a specific goal of examining stress response profiles and markers of immune function. This additional cross-sectional data is linked to women's regular WIHS profiles, thereby providing a unique opportunity to examine psychological predictors of biomarkers and psychological outcomes in WIHS.

Aim 3 consists of primary data collection, in which we obtained feedback from a group of N=8 women from the Chicago WIHS cohort, who took part in positive affect and coping skills

program over six weeks in order to provide preliminary data on acceptability and feasibility of this program for other WLWH. Versions of this evidence-based multi-component program, developed by Dr. Moskowitz and her team, have demonstrated efficacy in helping people cope with chronic health-related stress, including the stress of living with HIV.[72,73]

Methodology. Analyses were conducted using MPlus[74] and SPSS v. 25.[75] Data were examined to ensure that they met the statistical assumptions, and were transformed as necessary. We then conducted the following analyses:

Aim 1: Determine whether spirituality is related to viral load, and test potential mediators (positive affect, ART adherence) of this association in WLWH. We employed SEM in MPlus[74] to examine the relationship between spirituality, as assessed by the FACIT-Sp-12, and viral load over one year. Specifically, we examined whether any relationships seen between spirituality and viral load were mediated by positive affect or ART adherence.

Aim 2: Determine whether spirituality is related to immune markers and HPA axis activity in women. For this Aim, we employed regressions to examine whether spirituality, as assessed by the FACIT-Sp-12 or IWSR, or positive affect independently predicted TNFRII, IL-6, CRP, cortisol, and QOL. We then examined whether any relationships between spirituality or positive affect and TNFRII, IL-6, CRP, cortisol, and QOL were moderated by HIV status.

Aim 3: Conduct focus group sessions to assess acceptability and feasibility of a positive affect skills program for WLWH. During six 90-minute-long weekly focus groups, we obtained feedback on feasibility and acceptability of the positive affect skills program, and had one feedback session at the end wherein participants gave oral and written feedback on acceptability of the positive affect program for WLWH.

Contributions to the field. Answering the questions associated with these Aims advances our understanding of whether spirituality and positive affect have uniquely salubrious effects in HIV, and suggests ways to tailor positive affect programs to improve health and well-being of WLWH.

Study 1: The Relationship between Spirituality and Viral Load in the Women's Interagency HIV Study

Abstract

Background: Women living with human immunodeficiency virus (WLWH) have unique health challenges. Understanding pathways that help WLWH manage their disease and improve health outcomes is a critical step in reducing disease burden. Spirituality and positive affect have both been associated with better outcomes in HIV. It is unclear whether spirituality may reduce viral load through positive affect or through antiretroviral therapy (ART) adherence. **Methods:** We conducted a secondary analysis of data collected as part of the Women's Interagency HIV Study (WIHS), a prospective longitudinal cohort study in the United States. We examined whether spirituality, measured using the Functional Assessment of Chronic Illness Therapy Spiritual Well-Being Scale at index visit (2015) was associated with viral load one year later, and whether this relationship was mediated by positive affect measured using a Center for Epidemiologic Studies Depression Scale subscale and self-reported ART adherence at six months. **Results:** There was no direct relationship between spirituality and $\log_{10}$ viral load in the fully-controlled models. However, greater spirituality at index was related to higher ART adherence at six months ($B = 0.21$, $p < 0.01$), which, in turn, predicted $\log_{10}$ viral load at one year ($B = -0.24$, $p < 0.01$). Positive affect did not mediate the relationship between spirituality and viral load. **Conclusions:** Spirituality is associated with increased ART adherence among WLWH, which in turn, is associated with lower viral load. Interventions seeking to improve HIV care continuum outcomes among WLWH should consider integrating components of spirituality.

Introduction

Supporting people living with human immunodeficiency virus (PLWHIV) along the continuum of care to achieve viral suppression, which improves health outcomes and reduces transmission risk, has become essential to public health.[76] Supporting people living with HIV to become and remain virally suppressed, requires that they have convenient affordable access to HIV testing, become linked to HIV providers, and begin antiretroviral therapy (ART).[3] ART adherence is also necessary for continual viral suppression and prevention of HIV transmission.[4-6] In order to meet the federal target of helping 90% of those diagnosed with HIV attain viral suppression, we must improve care continuum strategies.[6]

Women living with HIV (WLWH) are vulnerable to a number of severe stressors and health challenges. In one study, 61% of WLWH reported gender-based violence exposure, and the estimated rate of intimate partner violence among WLWH is 55.3%.[8,9] Among WLWH, intimate partner violence is associated with a CD4+ count of <200, but not markers of adherence to antiretroviral medications including viral suppression and missed visits, suggesting that severe stressors including intimate partner violence and trauma may alter immune functioning in WLWH.[10] WLWH who report recent trauma have four times higher odds of antiretroviral failure independent of ART adherence as compared with WLWH without a history of recent trauma.[11] In addition, WLWH are more likely to suffer a lack of economic and educational opportunities and a history of racial and gender discrimination than HIV- women.[12-14] As compared to HIV- women, they are at increased risk of myocardial infarction, osteoporosis, cervical cancer, and birth control failure.[19] They are also at greater risk for liver and pancreas problems resulting from the use of HIV medication than are men.[19] Of WLWH in the United States in 2015, only 51% were retained in care.[1] Given women's severe vulnerability and unique

health issues related to HIV, studying pathways that may help women augment their health is crucial.

Negative psychological constructs, such as depression and anxiety, are associated with poorer outcomes in HIV, both in the wider HIV literature[20,76] and among WIHS participants specifically.[77-79] However, there is evidence suggesting that positive constructs like spirituality, defined as a multidimensional construct that includes a search for meaning and purpose, connection with a higher dimension, and experiences and feelings associated with said search and connection,[21] and positive affect, defined as positively valenced feelings (e.g., happy, calm, thrilled),[29] are related to better outcomes. For example, among mixed-gender samples of PLWH, those who show an increase in spirituality post-diagnosis have a slower decline in CD4+ T cells and maintain lower viral loads over four years.[23] Similarly, researchers have found that using spirituality to cope with stress in HIV is associated with an increased likelihood of achieving undetectable viral load over four years.[25]

Higher levels of positive affect, another positive psychological construct, at the time of HIV diagnosis have been associated with higher odds of engagement in care after three months with higher likelihood of remaining on ART.[33] In the Women's Interagency HIV Study (WIHS), a large prospective cohort study of WLWH and demographically similar HIV-negative women, Wilson et al. (2017) found that high positive affect was associated with suppressed viral loads in WLWH with low levels of negative affect. Positive affect and viral load were both dichotomized in these analyses, whereas negative affect was assessed continuously.[32] Few studies have looked at both spirituality and positive affect in relation to viral load, limiting our understanding of what psychological constructs most strongly predict viral load in WLWH and hindering development of interventions to improve health and QOL among WLWH.[19]

While there are indications that spirituality and positive affect exert beneficial health effects in HIV, the nature of the relationship between these two constructs is still poorly understood.[80,81] Positive religious coping, i.e. using aspects of religion or spirituality to cope with stressors, has been hypothesized to increase positive affect[80] and has been shown to predict greater spirituality, as assessed by the Functional Assessment of Chronic Illness Therapy—Spiritual Well-Being Scale-Expanded, among PLWH.[82] Importantly, some aspects of religious coping are relatively similar to methods shown to induce positive affect. For example, one aspect of this type of coping is Benevolent Religious Reappraisal, which is defined as "redefining the stressor through religion as benevolent and potentially beneficial."[83] Similarly, within the positive affect literature, positive reappraisal, or reframing a situation to see it more positively, has been shown to induce positive affect during stressful events.[84] Another aspect of religious coping is Religious Helping, or "attempting to provide spiritual support and comfort to others."[83] Performing acts of kindness has been shown to engender positive affect.[85] However, other aspects of religious coping, such as Collaborative Religious Coping, or "seeking control through a partnership with God in problem solving," and Seeking Spiritual Support, or "searching for comfort and reassurance through God's love and care," do not have clearly related concepts within the positive affect literature. Given the similarities between positive religious coping and interventions that specifically target positive affect, as well as the potentially unique beneficial aspects of spirituality, it is necessary to understand whether, as previously hypothesized, spirituality increased health via positive affect, or whether the relationship between spirituality and health is independent of positive affect.

Spirituality may also be related to better health outcomes in HIV through improved ART adherence. For example, a qualitative study on factors that predict better HIV adherence

indicated that prayer and spirituality were facilitators for adhering to HIV medications.[86] Also suggestive of a relationship between spirituality and increased adherence to medication, in 60% male sample of PLWH, people who were engaged in care (defined as keeping >= 90% of appointments over the past year, documented good ART adherence [not further defined], and Center for Adherence Support Evaluation Adherence Index[87] scores >10) were more likely than those who were not engaged in care to endorse e.g., being spiritual and/or religious, believing in an afterlife, and having more positive and less negative views of God.[88] Researchers have also found that spirituality mediates the positive relationship between social support and ART adherence.[89] However, it is unclear whether adherence is a significant mediator in the pathway between spirituality and better health outcomes in HIV.

Understanding whether and how spirituality predicts viral load in women living with HIV could help inform intervention content aimed at improving HIV care continuum outcomes. Moreover, understanding whether and how spirituality predicts viral load could have clinical utility, as if spirituality does predict viral load, providers may be able to help women achieve lower viral load by helping patients take advantage of their spirituality in ways that improve health. As such, we examined the relationship between spirituality and viral load in WLWH. Based upon previous literature, we hypothesized that both ART adherence and positive affect would mediate the relationship between spirituality and viral load (See Figures 1-1 and 1-2.) This work adds to the literature by advancing our understanding of whether spirituality is associated with viral load, and paths through which an association occurs.

Methods

Participants

This is a secondary analysis of data from the Women's Interagency HIV Study (WIHS). The WIHS is an observational prospective cohort study of both HIV-positive women and demographically similar HIV-negative women, with the first recruitment wave beginning in 1994.[69] There have been three subsequent waves of enrollment: from 2001-2002, 2011-2012, and 2013-2015.[70] Data for the current analyses are from participants at WIHS sites including New York City, Washington DC, San Francisco and the Bay Area, Chicago, Atlanta, Chapel Hill, Miami, and Birmingham. As spirituality differs by region across the United States,[90] it is essential to note that women from the Southern sites (Atlanta, Chapel Hill, Miami, and Birmingham) comprised 35% of participants at each time point in the dataset used for analyses in this study. Study index visit for analyses presented in this manuscript was WIHS enrollment visit 42 (04/01/2015 – 09/30/2015). Six month data was collected at visit 43, and follow-up information was collected at visit 44. Overall WIHS enrollment at index visit was N = 2343. However, current analyses were restricted to HIV+ women (n= 1630). Participants attend biannual visits in which they engage in a structured interview to provide demographic, psychosocial and medical information, obstetric/gynecological and contraceptive history, and report health sexual and substance use behaviors. Participants also undergo a physical and gynecological examination, and provide blood and cervical vaginal samples.[71]

Measures

Independent variable. The independent variable in the current analysis was spirituality, measured at study index visit 42 using the Functional Assessment of Chronic Illness Therapy - 12-item Spiritual Well-Being Scale (FACIT-Sp-12) [21]. Sample items include: "I feel a sense of purpose in my life," "My illness has strengthened my faith or spiritual beliefs," and "I know that

whatever happens with my illness, things will be okay." Items are scored on 5-point scale (0 - not at all to 4 - very much).

Dependent variable. The dependent variable was plasma HIV viral load (VL) measured continuously one year later (WIHS visit 44, 04/01/2016 – 09/30/2016).

Mediating variables. Mediating variables included positive affect and self-reported ART adherence. Positive affect was measured approximately six months after the index visit using the Center for Epidemiologic Studies Depression Scale (CES-D) positive affect subscale, which measures positive affect over the past week.[91] Example items include "I was happy," and "I felt hopeful about the future." CES-D items are scored from 0 (Rarely or none of the time [less than 1 day]) to 3 (Most or all of the time [5-7 days]). Self-reported ART adherence was measured one year after the index visit by response to: "In general, over the past six months, how often did you take your antiretrovirals as prescribed?" thereby capturing self-reported medication adherence for the six months preceding measurement of viral load, our dependent variable. Response options included: 100% of the time," "95-99% of the time," "75% - 94% of the time," "less than 75% of the time," and "I have not taken any of my prescribed medications." These categories were retained in analyses.

Covariates. We controlled for index visit viral load in all models. We also controlled for index visit positive affect in models wherein positive affect was being tested as a mediator, and for index visit ART adherence in models testing adherence as a mediator. In fully-controlled analyses, we controlled for age[92] (dummy coded as white [0] vs. non-white [1]), BMI [93], race,[94] income,[94] frequency of alcohol use,[95] WIHS recruitment wave,[96,97] and depressive symptoms, measured using the CES-D excluding positive affect items.[98] In addition, we controlled for

positive affect when examining the relationship between spirituality and viral load as mediated
by adherence to determine the independent effects of spirituality, separate from positive affect.

Analyses

Analyses included all HIV+ participants, including those with missing data on some
variables, as maximum likelihood estimation protects against bias that listwise deletion may
produce[99] and accounts for non-normality.[100] We first obtained descriptive statistics, and then
$\log_{10}$ transformed viral load for all three time points. We then examined bivariate correlations
between variables to assess multicollinearity using SPSS version 25[75]. Subsequently we
employed structural equation modeling (SEM) to examine whether spirituality is prospectively
related to $\log_{10}$ viral load one year later in MPlus version 7.31,[74] using maximum likelihood
estimation with robust standard errors. Specifically, we examined whether FACIT-Sp-12 scores
at index visit were related to $\log_{10}$ viral load one year later, with all variables measured
continuously.

We conducted fit comparisons between nested models (direct, partially mediated, and fully
mediated models) using Satorra-Bentler Scaled Chi-Square Difference Tests. We examined
STDYX standardized regression coefficients for all analyses.[101]

Results

Descriptive Statistics

A total of N = 1630 women (Age range = 26-81, M age= 49.88, SD = 8.96; 71.8%
African American, 10.9% White Non-Hispanic, 7.7% Hispanic, 4.6% White Hispanic, 1.8%
African American Hispanic, 0.6% Asian/Pacific Islander, 0.9% native American/Alaskan,
1.6 % Other) were included in this study. As stated in the methods section, 35% of participants
were from Southern WIHS sites. Additional descriptive statistics are in Table 1-1. Bivariate

correlations between variables of interest can be seen in Table 1-2. Bivariate correlations indicated that spirituality at index visit was not significantly correlated with viral load at one year ($r = 0.02$, $p = 0.41$). ART adherence at index ($r = -0.42$, $p < 0.001$) and 6 months ($r = -0.29$, $p < 0.001$) was correlated with viral load at follow-up. Similarly, positive affect at index visit ($r = -0.06$, $p < 0.05$) and 6 months ($r = -0.07$, $p < 0.05$) was correlated with viral load at follow-up. Importantly, n = 1394 participants (85.5%) had FACIT data at index, whereas n = 236 participants did not have FACIT data at index visit. There were no significant differences between groups regarding race, income at initial WIHS enrollment, ART adherence at six months, positive affect at six months, depressive symptoms at six months, or $\log_{10}$ viral load at one year.

Testing Nested Models

Chi-square difference tests allow researchers to examine whether a given model fits the data at hand significantly differently (i.e., better or worse) than a competing model.[102] However, multivariate nonnormality inflates overall goodness-of-fit chi-square statistics. Thus, Satorra and Bentler developed a chi-square test that accounts for bias due to multivariate non-normality, aptly called the Satorra-Bentler Scaled Chi-Square Difference Test.[103] We conducted Satorra-Bentler Scaled Chi-Square Difference Tests to compare fit between direct, partially mediated, and fully mediated models both for models in which we only controlled for viral load and adherence at index, as well as fully-adjusted models, in which we controlled for viral load at index and adherence at six months, cohort wherein women entered the WIHS study, age at follow-up, and BMI at follow-up, frequency of alcohol use at follow-up, income at WIHS enrollment, and race. Partially mediated models fit the data best for all models. See Table 1-3 for details.

Model Fit

While all x^2 statistics were significant, potentially indicating poor model fit, this statistic is sensitive to sample size and may not be reliable in the current investigation due to the large sample size.[104] We therefore chose to use indices including the root mean square error of approximations (RMSEAs), comparative fit indices (CFIs), and Standardized Root Mean Square Residuals (SRMRs), as seen in Table 1-4, to evaluate model fit.

RMSEAs are absolute measures of fit. Absolute measures of fit assume that the model that fits the data best has a fit of zero. Therefore, the closer the RMSEA is to zero, the better the fit.[105] RMSEAs of less than 0.05 or 0.06 indicate good fit, and RMSEAs between 0.05 and 0.10 indicate acceptable fit.[106,107] In the current study, RMSEAs indicated at least acceptable model fit for all models except for the model with ART adherence as a mediator where we controlled only for index ART adherence and index $\log_{10}$ viral load.

Like RMSEAs, SRMRs are absolute measures of fit.[105] SRMRs of less than 0.08 indicate good fit.[106,107] In this study, SRMRs indicated good fit for the models wherein ART adherence was a mediator and the greater number of covariates was included, and for the models wherein positive affect was a mediator and only index positive affect and index $\log_{10}$ viral load were included.

CFIs are incremental measures of fit, and are analogous to R^2.[102,105] CFIs at or above 0.95 indicate good fit.[106,107] In the current research, all CFIs were less than 0.95, indicating suboptimal fit. However, cutoff were created to be crude aids for interpretation and were based on intuition rather than mathematics.[107]

While it is clear that model fit is not optimal in the current study, we present path analysis results and recommend caution in their interpretation.

Path Analysis

When examining the relationship between spirituality and $\log_{10}$ viral load as partially mediated by adherence to ART over the past six months, we found that while there was no direct relationship between spirituality and $\log_{10}$ viral load in the statistically fully-controlled model ($B = 0.07, p = 0.08$), greater spirituality at index was related to higher ART adherence ($B = 0.21, p < 0.01$), which, in turn, predicted $\log_{10}$ viral load one year later ($B = -0.24, p < 0.01$). This indicates that there is a relationship between spirituality and viral load that is mediated by ART adherence.

When examining the relationship between spirituality and $\log_{10}$ viral load as partially mediated by positive affect at six months, we found that there was no direct relationship between spirituality and viral load one year later ($B = -0.00, p = 0.94$). Although greater spirituality led to higher positive affect six months later ($B = 0.61, p < 0.01$), positive affect at six months did not influence $\log_{10}$ viral load at one year ($B = -0.01, p = 0.77$). These results indicate that while spirituality leads to higher positive affect, positive affect does not mediate the relationship between spirituality and viral load.

See Table 1-5 for information about these relationships in models controlling only for adherence to ART at index and $\log_{10}$ viral load at index. See Figures 1-3 through 1-6 for path analysis diagrams with STDYX standardized regression coefficients for all models.

Discussion

This study found a statistically significant relationship between higher spirituality and lower $\log_{10}$ viral load one year later, which was mediated by adherence to ART. We also found that although there was a relationship between spirituality and positive affect, there was no relationship between positive affect and viral load. This literature expands upon previous research indicating that spirituality is a motivator for WLWH to better adhere to ART,[108]

demonstrating that spirituality predicts adherence behavior and ultimately decreased viral load among WLWH. Given these findings, we conducted additional exploratory analyses examining whether adherence to ART or positive affect mediated the relationship between spirituality and CD4+ count, whether spirituality predicted health care empowerment, and whether spirituality predicted health care utilization. See Appendices A-C.

Analyses in the current study necessitated the use of path analyses. Given the high rate of virologic success (<200 viral copies/mL)[109] defined by U.S. Department of Health & Human Services clinical practice guidelines[110] among study participants at follow-up (85.7%), we were unable to conduct path analyses examining the relationship between spirituality, mediators, and viral load dichotomized as virologic failure (≥200 viral copies/mL) or virologic suppression (<200 viral copies/mL),[109] as is commonly done in analyses with viral load as an outcome.

The one other study to date, by Wilson and colleagues, examining positive affect's prediction of viral load within the WIHS cohort demonstrated that positive affect predicts virologic suppression. Importantly, Wilson and colleagues used time points within the WIHS study (2011 – 2013) that differed from those in the current study, and as stated in the introduction, dichotomized positive affect and viral load.[32] When results of that study are taken alongside results in the current study, they suggest that positive affect may have more utility as a predictor of clinically relevant, dichotomized outcomes (e.g., viral load suppression) and as relevant to the care continuum than as a predictor of continuous biological measurements in HIV.[32]

Future directions

This study adds to the literature in an important way: Results indicate that higher spirituality leads to higher ART adherence six months later. Thus, if future research aligns with

the current study, it may be possible to develop interventions to help women use their spirituality to enhance ART adherence, which subsequently lowers viral load. Indeed, capitalizing upon spirituality as a method by which to enhance adherence, and subsequently decrease viral load, may assist researchers, clinicians, and patients as they work toward the national HIV/AIDS goal of reaching 90% viral load suppression.[6]

The majority of participants within the current study were African American, and a sizable minority of participants were from the Southern United States. It is therefore important to consider future directions specific to African American WLWH in the South. African American WLWH, and especially African American WLWH living in the South, may be able to profit from interventions that target spirituality to increase adherence especially effectively: Spirituality has historically been at the core of African American culture and evidence suggests that African American women place more value on spirituality as it relates to health than do women of other races.[111] African Americans WLWH rely heavily on spirituality as a source of strength and, in structured in interviews, cite it as a motivator to adhere to medications.[108] PLWH in the South also self-report higher levels of spirituality than PLWH in other regions of the country.[90] Thus, future research should examine acceptability and feasibility of conducting such interventions with African American WLWH, with a special focus on African American women living in the South.

While historically, 95% or greater adherence to ART was clinically believed to be required for sustained viral suppression, PLWH can achieve viral suppression at lower levels of adherence on some medications.[112,113] As the level of adherence for viral suppression differs by medication and women were on different medications, we did not dichotomize adherence to ART. Similarly, we did not account for change in ART regimen over time. Future researchers

have the opportunity to build upon the knowledge provided in the current manuscript by examining whether certain levels of adherence drive ART mediation in the relationship between spirituality and viral load.

As spirituality can be measured in a number of ways, it is possible that different spirituality measures would engender different results for the relationship between spirituality, mediators, and viral load. As such, future research should test the relationships between different measures of spirituality and biomarkers among WLWH.

Future research should continue examining relationships examined in the current study using self-report measures of ART with shorter recall periods such as ART adherence over the past week or past day, and different timeframes of positive affect (e.g., ecological momentary assessment). In addition, future research should examine the relationships between multiple measures of spirituality and different biological markers in HIV. The current study also brings to light the importance of examining novel positive psychological resources that may bolster the ability for women living with HIV to optimize their health. As multicomponent positive psychological interventions in people living with HIV have shown promise for improving physical and psychological health, [29,73,114] future research should examine the effects of including spirituality as an intervention component.

Clinically, it is important to note that primary providers' acknowledgement of spirituality may be an integral part of the HIV continuum of care. Research has indicated that among primary care patients, a substantial minority of patients, and a higher proportion of African American patients as compared to other racial groups, believe that providers' acknowledgment of patient spirituality is important.[115] As spirituality predicted medication adherence in the

current study, understanding whether patients wish to have discussions around spirituality, and then following through with said discussions, may assist with better adherence.

Limitations

This study has several limitations. Data on medication adherence was via self-report over a period of six months, which may have led to inaccuracies in participant reports. However, a meta-analysis has found that self-report ART adherence measures can distinguish between clinically relevant patterns of adherence behavior,[116] and self-report ART adherence been found to be strongly related to levels of antiretrovirals as measured in hair within WIHS.[117] Positive affect was measured over the past week, and there is evidence that daily recalled positive affect and ecological momentary assessment of positive affect are more closely associated with health outcomes than is positive affect measured over the previous week.[29,35] In addition, although we controlled for race and income, SES proxies, there are predictors of viral load that were not controlled for in the current study, including education,[118] employment,[119] and substance use.[120] It is possible that social support, or other factors associated with religiosity or spirituality that were not measured could influence viral load. As this was an observational study, we cannot be sure that spirituality is a significantly causal factor in a decrease in viral load; only that predicts said decrease. However, with continued research, it is possible that women living with HIV will be able to capitalize upon spirituality even more than they currently are doing so as to lead healthier lives to age successfully with HIV.

Study 2: Spirituality and Positive Affect: Independent Predictors of Biomarkers and

Quality of Life in Women Living with HIV?

Abstract

Background. While spirituality and positive affect have both been associated with better outcomes in HIV, it is not clear whether these constructs independently predict biomarkers and quality of life (QOL) in women living with HIV (WLWH) and demographically similar women who are not living with HIV. If spirituality and positive affect predict these important outcomes, it may be possible to improve the health and well-being of these women via interventions aimed at increasing spirituality and positive affect. **Methods.** We conducted multivariate hierarchical regressions to examine whether spirituality or positive affect independently predicts tumor necrosis factor receptors II (TNFRII), interleukin-6 (IL-6), C-reactive protein (CRP), cortisol, and QOL among WLWH and demographically similar women. We then conducted moderated regressions to examine whether HIV status moderated any relationships between spirituality or positive affect and the outcomes of interest. **Results.** Positive affect, but not spirituality, predicted TNFRII. One of two measures of spirituality and positive affect predicted QOL. Neither spiritualty nor positive affect meaningfully predicted cortisol, IL-6, or CRP. There was no moderation by HIV status. **Conclusions.** As positive affect and some aspects of spirituality predict biomarkers or QOL in WLWH and similar women, interventions should be developed to capitalize upon these two constructs to help women lead happier, healthier lives.

Introduction

Negative emotional states such as stress and depression are common in people living with HIV (PLWH) and present barriers to engaging in beneficial health behaviors and outcomes, such as adhering to antiretroviral therapy.[6,20] Moreover, women living with HIV (WLWH), are at significant risk for severe life stress and trauma, which may later stress-related physiology. For example, among women living with HIV (WLWH) participating in study, 61% reported gender-based violence exposure, and the estimated rate of intimate partner violence among WLWH is 55.3%.[8,9] Among WLWH, intimate partner violence is associated with a CD4+ count of <200, but not with markers of adherence to antiretroviral medications such as viral suppression and missed visits, suggesting that intimate partner violence and trauma may alter immune functioning in WLWH.[10] Given vulnerability and associated stress-related health outcomes among WLWH, it is crucial to enhance our understanding of potentially protective factors among this population.

In contrast to negative emotional states, positive psychological constructs, such as positive affect and spirituality, are uniquely associated with better outcomes in HIV. For example, positive affect, defined as positively valenced feelings (e.g., happy, calm, thrilled),[29] has been shown to be associated with increased engagement in care, reduced likelihood of mortality, and increased likelihood of viral suppression, independent of negative affect.[30-32] Spirituality, defined as a multidimensional construct that includes a search for meaning and purpose, connection with a higher dimension, and experiences and feelings associated with said search and connection,[21] often increases post-HIV diagnosis and is commonly used to cope with the stress of living with HIV.[22] Spirituality has been associated with slower disease progression and longer survival among PLWH.[23,24]

One likely link between positive affect and spirituality and better outcomes is through stress-related physiology (e.g., HPA axis activity, inflammatory biomarkers). While previous work suggests relationships between positive psychological constructs and stress-related physiology and health in HIV, we do not know whether positive affect and spirituality are each uniquely, or independently, predictive of better outcomes. Increased comprehension of the nature of the relationships is crucial to further development of positive psychological interventions for WLWH. The present study aims to address these gaps in the literature by illuminating whether spirituality or positive affect predicts immune function, HPA axis activity, and quality of life (QOL) among women in the Women's Interagency HIV Study (WIHS), a large prospective cohort study of WLWH and demographically similar women who do not have HIV.

Cortisol is a stress-related biomarker, elevated levels of which are associated with faster progression to AIDS and mortality.[34] As such, exploring the relationship between potentially protective psychological factors and cortisol in HIV is critical. Previous research has indicated that spirituality and positive psychological resources may be linked in their association with cortisol: Spirituality is related to benefit finding and positive reappraisal coping, and benefit finding is related to lower 24-hour urinary cortisol in PLWH.[31] Optimism, another positive psychological factor, and lower levels of overnight (15 hour) urinary cortisol have both been associated with decreased mortality in PLWH.[24] However, there is less information in the direct relationship between positive psychological factors, like positive affect and spirituality, and cortisol specifically in WLWH.

Markers of general inflammation, including interleukin-6 (IL-6) and C-reactive protein (CRP), are responsive to a host of predictors including, but not limited to exercise and adiposity.[121] Tumor necrosis factor receptor II (TNFRII), a receptor for the proinflammatory

cytokine TNF-α, is more acutely associated with immune-mediated inflammation.[122] These proinflammatory cytokines and inflammatory markers have also been implicated in poor health outcomes in HIV, and have shown to be inversely associated with positive psychological factors. For example, TNFRII activates immunosuppressive cells and promotes cervical cancer, for which WLWH are already at higher risk than women living without HIV.[36,37] TNFRII may have a role in CD8+ apoptosis occurring in pathogenesis of HIV,[38] and elevated levels of this receptor have been associated with HIV disease progression[39] and higher likelihood of the occurrence of non-AIDS-defining events.[40] Higher levels of IL-6 are associated with higher HIV viral loads.[45] In people who are not living with HIV, IL-6 is inversely associated with positive affect.[35,46] IL-6 also appears susceptible to emotional states within the context of HIV. Specifically, psychological stress, as measured by the Perceived Stress Scale[47] is correlated with higher IL-6 levels in PLWH.[48] Elevated levels of CRP, an inflammatory marker that increases in chronic inflammatory conditions, have been associated with progression to AIDS and mortality in WLWH not on ART.[41] Greater spirituality/religiosity has been meta-analytically associated with lower levels of CRP in HIV- samples.[123] Importantly, among patients living with chronic heart failure, positive affect dimensions of a number of different scales (The Global Mood Scale, Positive and Negative Affect Schedule, Hospital Anxiety and Depression Scale) have been associated with lower levels of TNFRII, IL-6, and CRP.[49]

Separate from biomarkers, better QOL has been associated with a lower likelihood of mortality among PLWH,[50] underscoring the importance of researching predictors of QOL in this population. A meta-analysis of 62 effect sizes over 51 studies examining the relationship between spirituality and QOL indicated that spirituality and QOL are positively correlated, with

a moderate effect size of $r = 0.34$.[51] Qualitative data has indicated that spirituality is an important part of QOL among PLWH.[52]

Focusing on links between positive affect or spirituality and stress-related physiology in WLWH is crucial, as among WLWH, intimate partner violence, which has been shown to affect 61% of WLWH, is associated with a CD4+ count of <200.[8,10] However, intimate partner violence does not appear to affect markers of adherence to antiretroviral medications including viral suppression and missed visits, suggesting that commonly experienced stressors such as intimate partner violence and trauma may alter immune functioning in WLWH.[10]

While research indicates that spirituality and positive affect are both related to important biomarkers and psychological outcomes in HIV, there is little information on whether spirituality or positive affect independently predicts biomarkers and QOL in HIV. Documenting predictors of biomarkers and QOL is essential to create programs and policies for improving health outcomes that are critical to slowing the progression of HIV. Moreover, examining whether spirituality and positive affect are independently associated with biomarkers and QOL in WLWH could spur the development of interventions that target these constructs, and provide information on shorter-term effects of interventions on health.[124] As such, we proposed to test the independence of the relationships of spirituality and positive affect with biomarkers including TNFRII, IL-6, CRP, and cortisol levels, and a psychological factor, QOL, in HIV+ and HIV- WIHS participants. We also examined whether positive affect predicted these outcomes differently in HIV+ and HIV- women.

Methods

Participants

This study was conducted using secondary data from the Women's Interagency HIV Study (WIHS). The WIHS is an observational prospective cohort study of both HIV-positive women and demographically similar HIV-negative women.[69] Women participate in study visits every six months, during which time they report sociodemographic, psychological, and medical history, obstetric/gynecological and contraceptive information, and describe their health behaviors including alcohol, tobacco, and other drug use, and sexual behaviors. In addition, participants go through physical and gynecological examinations, and provide plasma, serum, cells, cervical vaginal lavage, urine, and colon biopsy tissue samples.[71] Members of the WIHS Chicago cohort (N = 275) also participated in a cross-sectional psychoneuroimmunological (PNI) substudy, in which additional physiological and hormonal data were collected, with a specific goal of examining stress response profiles and markers of immune function. This additional cross-sectional data is linked to women's regular WIHS profiles, thereby providing a unique opportunity to examine psychological predictors of physiological outcomes in a longitudinal cohort of WLWH. The Chicago WIHS cohort has women who are both HIV-positive and HIV-negative.[70] Over both seropositive and seronegative women, a total of N = 275 women completed the cross-sectional PNI substudy in which investigators measured immunological and HPA-axis activity. For analyses examining the independence of predictive ability of spirituality and positive affect on biomarkers and QOL, we employed data from all available participants. For analyses examining moderation by HIV status, we employed data from n = 274 participants, as one participant was identified as being HIV+ at death but was considered HIV- while alive.

Measures

Independent variables. The independent variables for the current study are spirituality and positive affect. We used the Functional Assessment of Chronic Illness Therapy—Spiritual Well-Being Scale (FACIT-Sp-12)[21] and the Ironson-Woods Spirituality/Religiousness Index (IWSR).[24] Using both the FACIT-Sp-12 and the IWSR is essential to capture multiple dimensions of spirituality, as they measure different aspects of this construct: The FACIT-Sp-12 is a 12-item scale principally measuring inner peace, purpose, and coping, while the IWSR is a 25-item scale measuring beliefs, coping, and relational aspects of spirituality using more overtly spiritual and religious semantics.[125] Example FACIT-Sp-12 items include "I feel peaceful," and "I know that whatever happens with my illness, things will be okay."[21] Example IWSR items include "I believe my soul will live on in some form after my body dies," and "My beliefs give me a set of rules I must obey." Positive affect was measured with the positive affect subscale of the Center for Epidemiologic Studies Depression Scale (CES-D)[91]. Example items include "I felt helpful about the future," and "I was happy."

Dependent variables. Dependent variables include serum levels of TNFRII, IL-6, and CRP, overnight urinary cortisol, and self-reported QOL. WIHS PNI substudy participants provided serum samples and overnight urinary samples as a component of this substudy.

Soluble plasma IL-6 level quantitation was conducted using the Quantikine Human us-IL-6 Assay (ultra-sensitive IL-6 Assay) (R & D Systems, Minneapolis, MN), soluble plasma TNFRII level quantitation was conducted using the Quantikine Human TNF-RII/TNFRSF1B Assay (R & D Systems, Minneapolis, MN), and soluble plasma CRP level quantitation was conducted using the Human us-CRP Assay (ultra-sensitiveCRP Assay) (Elabscience, Houston, TX). All plasma biomarkers were assayed at the Hektoen Institute of Medicine Women's Research Laboratory. Plasma for biomarker testing was isolated from whole blood collected in

Becton Dickinson Vacutainer Mononuclear Cell Preparation Tubes (CPT)-Sodium Citrate and spun for 20 minutes at 1500 x g. The plasma was removed, placed in a 50 ml conical, and spun for 10 minutes at 1000 x g. The plasma was then aliquoted in 1 mL aliquots and stored at -70C until tested.

Cortisol follows a daily rhythm, peaking shorting after awakening and decreasing throughout the day. So as to obtain an accurate measurement of one's cortisol profile, it is ideal to acquire cortisol samples over a period of 24 hours. However, this is burdensome for patients and, in the case of urinary cortisol, sampling is often inaccurate. One comparably accurate alternative is to obtain overnight urinary cortisol samples.[126] In order to decrease participant burden and maintain high levels of sampling accuracy, participants in the current study were only asked to provide overnight urinary samples (i.e., providing a urinary sample upon first morning void). Quest Diagnostics Nichols Institute in Chantilly, VA assayed urinary cortisol. Calibration was prepared by Quest from a certified Cerilliant standard, and the Standard Curve is tested in each assay.

In WIHS, Bozzette and colleagues developed a shortened version of the Medical Outcome Study (MOS)-HIV QOL instrument. The shortened version has 21 items over 9 domains, including physical functioning, role functioning, energy/fatigue, social functioning, cognitive functioning, pain, emotional well-being, perceived health index, and current health perception. QOL scores are calculated according to a pre-specified formula: (0.20 x physical functioning) + (0.17 x pain) + (0.28 x energy/fatigue) + (0.20 x emotional well-being) + (0.05 x social functioning) + (0.10 x role functioning).[127]

Moderating variables. For all moderated regressions, the moderating variable was HIV status.

Control variables. For all multivariate hierarchical regressions, we controlled for age[128-130] race,[131-133] and education.[130,131,134] We dummy coded race as white (0) vs non-white (1). For analyses related to cortisol, we also controlled for urinary creatinine (UCr).[135] Measurement of cortisol is affected by urine concentration, and controlling for UCr corrects for this.

Analyses. All analyses were conducted using SPSS v. 25.[75] TNFRII, IL-6, CRP, and cortisol values were $\log_{10}$ transformed due to non-normality. We employed multivariate hierarchical regressions in SPSS to assess whether spirituality and/or positive affect independently predicted TNFRII, IL-6, CRP, cortisol, or QOL, with both spirituality and positive affect entered into the model at the same time. We then used the PROCESS Macro within SPSS to conduct moderated regressions. Herein, we examined whether HIV status moderated any relationships between spirituality or positive affect, as assessed by the FACIT-Sp-12,[21] IWSR,[24] or the CES-D positive affect subscale,[91] and TNFRII, IL-6, CRP, cortisol, and QOL. All variables, except for HIV status, were measured continuously.

Results

Descriptive Statistics. See Table 2-1 for descriptive statistics. usCRP and usIL-6 levels were similar to levels in PLWH reported elsewhere,[136,137] cortisol levels were slightly lower than in research with HIV+ WIHS participants reported elsewhere,[138] and TNFRII levels were lower than in a study with co-infected HIV+/hepatitis C WIHS partipants.[139] Regarding race, 76.0% of participants identified as African American non-Hispanic, 12.4% of participants identified as White non-Hispanic, 5.1% of participants identified as White Hispanic, 1.5% of participants identified as African American Hispanic, 4.4% identified as Other Hispanic, 0.4% identified as Native American/Alaskan, and 0.4% of participants identified as Other. Concerning highest level of education achieved at the point of study start, 0.7% of participants had completed grades 1-6,

30.5% had completed grades 7-11, 27.6% had completed high school, 30.9% had completed

some college, 7.6% had completed four years of college, and 2.5% had attended or completed

graduate school.

Bivariate correlations and multivariate hierarchical regressions.

Cortisol. There were no significant bivariate correlations of the FACIT-Sp-12, IWSR, or

positive affect with cortisol. See Table 2-2. Unsurprisingly, when we entered the FACIT-Sp-12

and positive affect into a regression model with UCr as a covariate, the F value of the model was

not significant. This means that while, in this model, the FACIT-Sp-12 ($\beta = -0.26$, $p < 0.05$) and

positive affect ($\beta = 0.25$, $p < 0.05$) independently predicted cortisol in this model, they did not do

so in a way that differed significantly from the null model. When adding age, race, and education

into the model, the F value of the model remained non-significant. This means that while, in this

model, the FACIT-Sp-12 ($\beta = -0.26$, $p < 0.05$) and positive affect ($\beta = 0.27$, $p < 0.05$)

independently predicted cortisol, they did not do so in a way that different significantly from the

null model. See Tables 2-3 and 2-4.

When we entered the IWSR and positive affect into a regression together with urinary

creatinine as a covariate, the F value of the model was not significant, and neither the IWSR nor

positive affect predicted cortisol. When adding age, race, and education into the model, the F

value of the model was not significant, and neither the IWSR nor positive affect predicted

cortisol. See Tables 2-3 and 2-4.

TNFRII. Bivariate correlations between positive affect and TNFRII were significant,

whereas correlations of the FACIT-Sp-12 or IWSR with TNFRII were not. See Table 2-2. When

we entered the FACIT-Sp-12 and positive affect into a regression model together as predictors of

TNFRII, the F value was statistically significant. Analyses revealed that positive affect ($\beta = $ -

0.18, $p < 0.05$), but not spirituality as measured by the FACIT-Sp-12, predicted TNFRII. When adding age, race, and education into the model as predictors, the F value was statistically significant, and positive affect ($\beta = -0.18$, $p < 0.05$), but not spirituality as measured by the FACIT-Sp-12, predicted TNFRII. See Tables 2-3 and 2-4.

When we entered the IWSR and positive affect into a regression model together as predictors of TNFRII, the F value was statistically significant. With the IWSR and positive affect as predictors of TNFRII, positive affect ($\beta = -0.19$, $p < 0.01$), but not spirituality as measured by the IWSR, predicting TNFRI. When adding age, race, and education into the model, the F value was statistically significant, and positive affect continued to be an independent predictor of TNFRII ($\beta = -0.19$, $p < 0.05$). See Tables 2-3 and 2-4.

IL-6. There were no significant bivariate correlations of the FACIT-Sp12, IWSR, or positive affect with IL-6. See Table 2-2. When we conducted regressions with the FACIT-Sp-12 and positive affect in the model as predictors of IL-6, the F value was not significant, and neither FACIT-Sp-12 nor positive affect predicted IL-6. When we added age, race, and education into the model, the F value of the model became significant, but neither FACIT-Sp-12 nor positive affect predicted IL-6. See Tables 2-3 and 2-4.

When we conducted regressions with the IWSR and positive affect in the model as predictors of IL-6, the F value was not significant, and neither the IWSR nor positive affect predicted IL-6. When we added age, race, and education into the model, the F value of the model became significant, but neither the IWSR nor positive affect predicted IL-6. See Tables 2-3 and 2-4.

CRP. There were no significant bivariate correlations between the FACIT-Sp12, IWSR, or positive affect with CRP. See Table 2-2. When we conducted regressions with the FACIT-Sp-

12 and positive affect in the model as predictors of CRP, the F value was not significant, and neither FACIT-Sp-12 nor positive affect predicted IL-6. When we added age, race, and education into the model, the F value of the model remained non-significant, and neither FACIT-Sp-12 nor positive affect predicted CRP. See Tables 2-3 and 2-4.

When we conducted regressions with the IWSR and positive affect in the model as predictors of CRP, the F value was not significant, and neither the IWSR nor positive affect predicted CRP. When we added age, race, and education into the model, the F value of the model remained non-significant, and neither IWSR nor positive affect predicted CRP. See Tables 2-3 and 2-4.

QOL. Bivariate correlations of the FACIT-SP-12 or positive affect with QOL were significant, whereas the IWSR was not correlated with QOL. See Table 2-2. When examining whether spirituality, as measured by the FACIT-Sp-12 and/or positive affect independently predicted QOL, the F value for the model was significant. When conducting regressions with only the FACIT-Sp-12 and positive affect in the model, we found that both spirituality, as measured by the FACIT-Sp-12, ($\beta = 0.26$, $p < 0.01$), and positive affect ($\beta = 0.22$, $p < 0.01$) independently predicted QOL. When we added age, race, and education into the model, the F value remained significant. Both spirituality, as measured by the FACIT-Sp-12 ($\beta = 0.27$, $p < 0.01$) and positive affect ($\beta = 0.20$, $p < 0.01$) continued to independently predict QOL. See Tables 2-3 and 2-4.

When we conducted regressions with only the IWSR and positive affect in the model predicting QOL, the F value of the model was significant. While positive affect ($\beta = 0.36$, $p < 0.01$) predicted QOL, spirituality, as measured by the IWSR, did not. When we added age, race,

and education into the model, the F value remained significant, and positive affect predicted QOL ($\beta = 0.35$, $p < 0.01$), while the IWSR did not. See Tables 2-3 and 2-4.

Moderated regressions

HIV status did not moderate any relationships between spirituality and outcomes of interest, or between positive affect and outcomes of interest. This means that there were no significant differences between women living with and without HIV in TNFRII, IL-6, CRP, or QOL. See Table 2-5.

Discussion

This comparison of the predictive ability of spirituality and positive affect in relation to biomarkers and QOL adds to the understanding regarding which psychological factors predict facets of health, and reinforces the idea that positive affect and spirituality are distinct concepts with unique benefits. Higher positive affect predicted lower TNFRII, but there was no association between spirituality, as measured via the FACIT-Sp-12 or IWSR, with TNFRII. Both the FACIT-Sp-12 and positive affect independently predicted higher QOL, a finding that held when controlling for age, race, and education. However, when examining whether the IWSR and positive affect independently predicted QOL, only positive affect showed predictive abilities, such that higher positive affect predicted higher QOL. Neither spirituality nor positive affect independently predicted cortisol, IL-6, or CRP in a meaningful way.

Results provide preliminary evidence that positive affect is more predictive of TNFRII than is spirituality in WLWH. Mechanisms remain unclear. Two potentials reasons for the lack of association of positive affect with IL-6 and CRP are that, perhaps, in WLWH, there is no association of positive affect with IL-6 and CRP and the measurement of positive affect. First, whereas both IL-6 and CRP are markers of general inflammation and TNFRII is more directly

associated with the immune system,[121,122] findings from the current study point toward positive affect exerting its effects on inflammation via the immune system. Secondly, in the current study, we used the positive affect subscale of the CES-D to assess relationships among women living with and without HIV. In a study in which Steptoe and colleagues examined the relationship of positive affect, assessed with ecological momentary assessment, with IL-6 and CRP among healthy women in the Whitehall II cohort, results indicated that positive affect was associated with lower inflammation using both markers.[140] As there was no moderation of TNFRII by HIV status, it is likely that positive affect measurement is one likely source of the differing findings between the current study and that of Steptoe and colleagues. It is clear that more research is needed.

As the FACIT-Sp-12 and positive affect independently predicted QOL, it appears that both spiritualty and positive affect are important predictors of QOL in WLWH and demographically similar women. However, as when we examined whether the IWSR and positive affect were independently predictive of QOL in WLWH and demographically similar women, only positive affect was significant, researchers must consider the nuances of what the FACIT-Sp-12 captures (e.g., inner peace, purpose, coping), what the IWSR captures (e.g., beliefs, coping, and relational aspects of spirituality using more overtly spiritual and religious semantics),[125] and where these scales might have differential predictive abilities. Differing findings by spirituality scale might be due to a lack of alignment between spiritual and religious beliefs and QOL.

As results of the moderation analysis we conducted indicated that there was no moderation by HIV status for any outcomes of interest, we can consider that the findings are robust between both WLWH and women living without HIV.

Limitations. It is likely that positive psychological factors improve biomarkers and QOL in a more complex manner than we are able to see in the current study. For example, it is possible that TNFII levels predict QOL in HIV. In addition, we did not control for variables that may predict biomarkers and QOL including sleep quality, body mass index, smoking, and illicit substance use due to potential confounding with both predictors and outcomes of interest. Moreover, although current analyses were conducted in a national sample of WLWH and demographically similar women, findings may not generalize to men or to women who are demographically dissimilar. Data were treated as cross-sectional in analyses, so direction of effect cannot be determined. Importantly, we were unable to control for comorbidities in the current study, some of which may influence cytokines.

Future directions. Future research must elucidate exactly which components of spirituality are most important to QOL in WLWH and demographically similar women. In addition, while this study provides evidence that spirituality and positive affect function differently as independent predictors of biomarkers and QOL in WLWH, future researchers must examine whether similar results arise when examining these relationships in men living with HIV, as well as demographically dissimilar WLWH. For example, it is possible that immune-related biomarkers and QOL are not predicted in the same way in WLWH with significantly different socioeconomic statuses than women in the current study. Researchers should also examine whether level of positive affect moderates any relationship between HIV status and quality of life. Moreover, researchers may consider testing whether positive affect interventions are capable of reducing TNFRII levels in WLWH, and whether spirituality and positive affect interventions are capable of increasing QOL in WLWH. It is possible that feasible, acceptable,

efficacious interventions could be woven into clinical practice, helping WLWH leader happier,

healthier lives.

Study 3: Feasibility and Acceptability of a Program to Increase Positive Affect, Reduce Self-Silencing, Increase Communication Skills, and Improve Self-Care in Women Living With HIV

Abstract

Background: Women living with human immunodeficiency virus (WLWH) have unique health challenges. While programs and interventions intended to increase positive affect among people living with HIV and other chronic diseases have been associated with improved health outcomes, programs have not been tailored specifically for women. **Methods:** We tailored a program intended to increase positive affect in people living with HIV to be acceptable and feasible for WLWH, adding skills to an existing positive affect program including decreasing self-silencing, increasing communication skills, and improving the ability to engage in self-care, and tailoring the program to function in a group format. We then tested the acceptability and feasibility of this program in a group format of WLWH in Chicago, IL. **Results:** The program was deemed both acceptable and feasible by women, who also gave feedback suggesting optimal delivery point (e.g., at HIV diagnosis). **Conclusions:** A proof-of-concept program intended to bolster positive emotion regulation, decrease self-silencing, increase communication skills, and increase the ability to engage in self-care can be tailored for WLWH, and is feasible and acceptable. Future iterations of the program should capture participant feedback via audio recording both during program sessions and during a feedback session, and should query women about how the program affected them personally.

Introduction

Understanding predictors of optimal psychological outcomes for people living with

human immunodeficiency virus (HIV) is a critical public health issue, as positive psychological

constructs, such as positive affect and spirituality, are associated with better outcomes in HIV

including increased engagement in care, reduced likelihood of mortality, and increased

likelihood of viral suppression.[24,30-32]

As such, our group has begun testing multi-component interventions intended to increase

positive affect in people living with HIV or other health-related stress.[29,141,142] In a large

randomized trial, we tested a positive affect intervention on a mostly male (91.7%) sample of

people recently diagnosed with HIV. The intervention was delivered via one-on-one in-person

sessions, and the protocol included teaching participants the following skills: noticing and

capitalizing on positive events,[53-55] gratitude,[56-58] mindfulness,[59] positive reappraisal,[60,61]

focusing on personal strengths,[62] achieving attainable goals,[63,64] and engaging in Altruistic

Behaviors or Acts of Kindness.[65,66] Results indicated that at ten months post-intervention,

participants in the intervention group reported higher past-day positive affect, reductions in

intrusive and avoidant thoughts about HIV, and a lower likelihood of being on antidepressants as

compared to the control group.[29]

While the multicomponent positive affect intervention has been tested in mixed-gender,

mostly male, samples of people living with HIV in a one-on-one format, it is crucial to tailor

interventions intended to increase positive affect for women specifically, as women living with

HIV (WLWH) are an especially vulnerable population. For example, of WIHS participants, 61%

self-report lifetime gender-based violence exposure, and the estimated rate of intimate partner

violence among WLWH is 55.3%.[8,9] Importantly, biological and transgender WLWH who

report recent trauma have more than four times greater odds of antiretroviral failure independent of adherence as compared with women who have not experienced recent trauma.[11] In addition, WLWH are more likely to suffer a lack of economic and educational opportunities and a history of racial and gender discrimination than HIV- women.[12-14] WLWH also tend to engage in self-silencing, or not stating their needs in order to maintain harmony.[16] Self-silencing among WLWH has been associated with a lower likelihood of engaging in safe-sex behavior[17] and a lower likelihood of achieving ≥95% antiretroviral therapy (ART) adherence over six months.[18]

However, positive psychological constructs have salubrious effects among WLWH and mixed-gender samples of PLWH. Specifically, self-compassion has been associated with lower depressive symptoms in mixed-gender samples of PLWH, and self-care has been associated with higher health-related quality of life in WLWH[143,144] In addition, the inverse of self-silencing, self-advocacy, has been shown to be beneficial for interacting with the health care system, obtaining and adhering to ART, and effectively engaging in self-care among WLWH.[16] In addition, positive affect has been associated with an increased likelihood of viral load suppression among WIHS participants.[32] Furthermore, spirituality, which often strengthens post-diagnosis of HIV, is linked to slower disease progression and longer survival among PLWH.[23,24] Using spirituality to cope with stress in HIV has been associated with lower viral load, and people who show an increase in spirituality post-HIV diagnosis maintain lower viral loads as compared to their peers.[23,25] Indeed, one study examining the use of spirituality among African American WLWH found that 80% of participants prayed once a day or nearly every day, and 40% meditated at least once a week.[26] In this same study, 95% of participants said that spiritual beliefs were very or extremely important to them, underscoring the importance of

spirituality among WLWH.[26] Among WIHS participants specifically, research has suggested that loving kindness meditation may be a useful component of managing HIV care.[27]

Importantly, the HIV incidence rate is seven times higher among African Americans than Caucasian Americans in the United States,[145] and 77% of women recently diagnosed with HIV in the United States are African American or Latina.[11] Spirituality has historically been at the core of African American culture and evidence suggests that African American women place more value on spirituality as it relates to health than do women of other races.[111] African Americans WLWH rely heavily on spirituality as a source of strength and, in structured in interviews, cite it as a motivator to adhere to medications.[108]

Given the importance of increasing self-advocacy, self-care, self-compassion, and positive affect, and spirituality more generally among WLWH, we tailored the multicomponent positive affect intervention previously employed in mixed-gender samples of people living with HIV to test feasibility and acceptability of a group program intended to also increase self-advocacy, self-care, and self-compassion among WLWH. We also examined whether it would be useful to modify this program to include more overtly spirituality-related content. In this paper, we report on the development of a tailored group program for WLWH and report preliminary feasibility and acceptability of a proof-of-concept trial.

Objectives we aimed to address in this proof-of-concept study were 1) feasibility and acceptability of delivery 2) feasibility and acceptability of content 3) optimal timing of the program with regard to proximity to HIV diagnosis 4) inclusion of particular skills (i.e., Should we add or remove certain skills?) and 5) other helpful modifications (including the potential addition of spirituality content).

Methods

The study was approved by Institutional Review Boards at participating institutions.

Development

A multidisciplinary team of investigators modified the content of the multi-component positive emotion regulation intervention previously tested in mostly male sample of people recently diagnosed with HIV.[29] The current intervention was modified to be more acceptable and appropriate for women by adding in content regarding self-assertiveness, decreasing self-silencing, and self-care, based upon previous research on the needs of WLWH.[146] The team followed an iterative process in which we exchanged drafts of program content to modify said content to be more acceptable to WLWH and applicable to the problems that they may be facing. In addition to content modification, the team iteratively transformed the previous intervention, which was delivered one-on-one, into a group format, with the intention that women would derive support from one another and enjoy learning the skills in a group. We also created workbooks for participants that had the week's lesson, suggested homework, and pages for jotting down notes so that women would be able to remember program content at home and continue to use it if they saw fit to do so.

Participants and Procedures

All participants were enrolled in the Women's Interagency HIV Study (WIHS), an observational prospective cohort study of HIV positive and demographically-similar HIV-negative women.[69] Participants were eight Black seropositive women from the Chicago WIHS site with a history of lifetime trauma, and a history of chronic depressive symptoms as measured by CES-D scores consistently higher than 16.[91] Participants were recruited by the project director of the WIHS Chicago cohort based upon participants' high previous willingness to engage with WIHS initiatives, and their desire to help develop a program to assist other WLWH. WIHS

participants have provided consent to use their data identify if they are eligible for substudies or other research activity.

After engaging with study staff in a recruitment phone call, participants were invited to attend six weekly in-person sessions at the WIHS Chicago location, each 2 hours in length. There was one two-hour-long feedback session subsequent to the program. See below and Table 3-1 for more detailed information on session content.

One researcher (S.B.) sat in on every session and took process notes. She also sat in on the feedback session to obtain information from participants regarding what they thought would work well for WLWH and what modifications they suggested. Due to IRB restrictions, we were not able to obtain information on participants (e.g., pre/post measures) or use any kind of recording device, but we were able to obtain information regarding the program itself (e.g., its applicability to WLWH, modifications that should be made, etc.). Thus, this was the only information obtained.

All program sessions took place in the WIHS Chicago clinic. The first six sessions taught psychological skills, with the seventh session was reserved for feedback. Participants learned the skills from a trained facilitator in a group setting for 1.5 hours, and then filled out weekly feedback questionnaires. In the week following each session, they were asked to complete homework intended to solidify understanding of skills learned in that session. Participants were reimbursed for transportation costs, received a $20 gift card at each session, and were given lunch at each session. Investigators met after each session to provide feedback regarding the week's session had gone, and minimal additional tailoring was completed at this point. For example, if it became clear that the next week's session would be too long, investigators would discuss e.g., which skill-use examples or exercises might be dropped.

During a final feedback session, participants came into the WIHS Chicago office to give written and oral feedback about the acceptability and feasibility of conducting these sessions with WLWH.

Session Content

See Table 3-1 for an overview of skills taught, rationale for skill inclusion, and weekly homework. Sessions 2-6 began with the facilitator asking whether participants had completed the previous week's homework, and about barriers and facilitators to completion. In sessions 3-6, the facilitator led the group in "three breaths of arrival," a very short mindfulness practice in which participants focused on their breath as they inhaled and exhaled three times, previous to learning new skill content. For all sessions, the facilitator then taught new skills to women, and helped them think through times wherein they could use the week's skills. The week's homework was introduced at the end of the session.

Feasibility and Acceptability

Feasibility. We assessed feasibility via the number of women who were contacted and agreed to be in the study, and the number of participants who attended each session.

Acceptability. We assessed acceptability of individual sessions on a weekly basis and of the overall program after all sessions were completed. See below for details.

Acceptability of individual sessions. Participants completed self-report questionnaires at the end of each session regarding whether this program, and particular skills learned that week, would be useful for WLWH. The facilitator handed out weekly feedback packets, and women left the self-report questionnaires on the table at which they were sitting for program sessions while the facilitator was in and out of the room bringing lunch to the women. Once all participants handed in their questionnaires, the facilitator then took the questionnaires

from the table. On a 1-10 scale, women scored clarity skill presentation, likely helpfulness of skills for WLWH, likely level of motivation of WLWH to use the skills, likely fit of skills with spiritual beliefs (or lack thereof) of WLWH, and likely helpfulness of homework to WLWH.

Acceptability of program overall. Participants gave feedback regarding feasibility and acceptability of the program delivery and content to the principal investigator of the Chicago WIHS site (K.W.), who was not directly involved with program facilitation. Themes asked about were appropriateness of session length, whether this program would be better in a group or individual format, when this program would be most useful in relation to HIV diagnosis, which skills would be useful proximal to HIV diagnosis, which skills were useful even to women who were not recently diagnosed, and whether this program should be peer-led.

In addition, participants at the feedback session completed part of an extensive feedback questionnaire. Due to the significant length of the feedback packet, the principal investigator of the WIHS Chicago site asked two participants to start at the beginning of the feedback session and answer questions until halfway through the questionnaire and asked the two remaining participants to answer questions beginning halfway through the packet until the end. Example items include, "How could the group be improved for women living with HIV?" and "How do you think the program skills fit in with the spiritual beliefs or practices of women living with HIV?"

As stated above, a researcher on the team (S.B.) observed all sessions in which content was delivered, as well as the feedback session. S.B. observed sessions to provide process notes and a researcher's perspective on acceptability. Notes consisted of how participants responded to facilitator questions and prompts, and some information regarding when participants appeared

engaged or disengaged with the material. We chose to include information in the manuscript that aligned with our stated objectives, and to include salient quotes.

<div align="center">

Results

</div>

Feasibility of Development

Working with a multidisciplinary team of researchers, it was feasible to customize this program for a small proof-of-concept study with WLWH.

Feasibility and Acceptability of Delivery

A total of N = 8 women were contacted and agreed to participate in this substudy, one of whom did not participate in any sessions. Seven women attended the first session. Subsequently, between 4 and 6 women attended each session.

Program strengths. Women talked about the fact that they were "learning something here" in multiple sessions. They reportedly told their friends that they had to go to class or school when they were talking about the program. The concept of continued education seemed especially important to participants as they all seemed to value education highly at this point in their lives. Women appeared to want connection with other women who have been living with HIV, especially with regard to using the skills. Similarly, women seemed to want to read out loud in front of other women in order to improve their literacy skills in a safe space. Throughout sessions, women said that they hadn't previously known how good their lives were, and coming to this group made them realize that they had a lot to be grateful for. Women also seemed to draw solace from speaking with other women about the problems that they were going through.

Food and drink. At the start of each session, coffee and tea were available, allowing for a soft start and time for community building. One benefit of this soft start was that women who were arriving late missed less session material than they would have. In addition to the receiving

beverages at session start, which seemed to make women feel cared for, women were excited about receiving food for lunch. However, one woman noted that the actual quality of the food was her least favorite part of the program. When there was extra food due to one or more participants not coming to a particular week's session, participants who were in attendance asked to take home the extra food.

Distractions. It was very common to get significantly off-topic during conversation, which took time away from learning and discussing materials. Participant phones were a distraction and took away a significant amount of attention from participants throughout the program and in the feedback session. There was also a vast difference between women regarding how much people spoke during sessions, which led some women to leave the room when other women talked at length.

Leadership & Group Structure. In the final feedback session, one participant said that she liked this group much more than groups wherein participants just provide information via diaries, etc., because she felt was though she was learning something. She stated, "This is a good group because it's a *learning* group. This group was to teach skills and to learn skills, which was important." When asked if it would be better for women to learn the skills as a group or as an individual, women explained that the group process was good for interpreting their own lives, and for feeling gratitude for where they are in their lives. When asked whether learning these skills in a group or individually was preferable, women stated that it was helpful to learn from other women and to process how these skills could be helpful in a group setting. When asked if this group should be peer led, one participant gave a resounding no, one shook her head vigorously against the idea, and one participant noted that it would be for another WLWH to lead the group, saying, "It would be touchy to have someone switch from peer to staff and back."

Participants explained that they want to have this group led by someone who can keep them on task and learning the skills. They want to be led by someone who can take them back to the material fairly quickly if anyone goes off topic.

Time. When queried about time, three of four participants stated that it would be helpful to have less content per session and longer sessions. They stated that two hours of materials would be better than one and a half hours. One participant disagreed, and stated that she was pressed for time as it was in this program. Women wanted the time within the program to be more focused on the material that they were there to learn, with less time dedicated to having women talk about their problems. They suggested that this way, the facilitator could more easily get through all intended material. They noted that it would be preferable for the facilitator to be more controlling and have each participating woman give *limited* feedback when e.g., giving examples of times that these skills would be useful. Participants liked the idea of having a rule about time limitations for talking on the board and going over it every week.

Feasibility and Acceptability of Content

Weekly feedback. Participants' weekly feedback ratings indicated a highly acceptable program with regard to clarity of skill presentation, perceived helpfulness of each skill to WLWH, perceived likely motivation of WLWH to use the skills, fit with spiritual beliefs and practices of WLWH, and helpfulness of homework to other WLWH. On a 1-10 scale, women scored clarity of all skill presentation high (range = 9.43 - 10), said that the skills would be helpful for WLWH (range = 9.60 – 10), said that women would be motivated to use the skills (range = 9.67 – 10), that skills would be good fits with the spiritual beliefs of women (range = 9.33 – 10), and said that the homework would be helpful to other WLWH (range = 9.83 – 10).

Feedback from session 7 (feedback session). Participants noted that self-care, self-advocacy, and communication were of prime importance independent of timing of the program in relation to HIV diagnosis, as were learning self-compassion and mindfulness. Participants delved further into the utility of self-care, goal setting, and mindfulness:

Self-care. When the group was discussing self-care in the feedback session, one participant stated, "That self-care is like the golden part for me." This was especially important for the women from a caretaking perspective, as all of the women had children and/or grandchildren. One participant thought for a minute, and noted, "If you're a caretaker with HIV, you're taking care of everybody else but nobody is taking care of you," and that "we need to be able to take care of us." One participant told the group that her doctor was encouraging her to engage in self-care, and indicated that information that participants learned in the program aligned with and supported her doctor's recommendations. Participants kept coming back to the self-care session and saying that self-care was crucial. They agreed that mindful breathing was a component of self-care, and the people at the feedback session all said that they were using three breaths of arrival in their daily lives and truly loving this skill.

Goal setting and related skills. During the feedback session, women suggested that setting goals would be very helpful for dealing with denial and confusion surrounding diagnosis of HIV and living with the virus. One participant gave an example of how setting goals was important for her dealing with confusion: She was having trouble with her health, and set the attainable goal of seeing her doctor. She set two more goals for what she wanted to accomplish within her appointment: She set the goals of remember what she is entitled to as a person and using active communication skills to facilitate better patient-provider interactions. Similarly, during the feedback session, one woman indicated that she had just filled her prescription for

antiretroviral medication. She said that self-care, lovingkindness, kindness, goal setting, and mindfulness were the skills that helped her get to the point that she could accomplish this.

Mindfulness. When the group was discussing that mindfulness was very helpful, one member expanded on how it was helpful by stating, "When you're in a situation, just breathe. When you're getting into a situation where you're losing your self-care, being able to stop, breathe, and reset is critical for you to get to self-care." However, during one of the sessions that taught mindfulness, one participant broke into tears because she was reminded of something traumatic that happened to her, as sitting still invoked a flood of memories.

Timing of Learning the Skills in Relation to HIV Diagnosis

Women noted that some aspects of the program would have been especially helpful more proximal to HIV diagnosis. However, they said that the group and certain skills were still of great use to them at this time on their journeys of living with HIV.

When asked at what point in life a program like this would be most useful, one woman noted, "My struggle would have been easier if I'd learned this stuff earlier on." Another stated, "Had I had something like this when I first diagnosed, I think I'd be further in life. I couldn't find a group that would actually help me grow." When queried regarding which skills would have been useful if they had been taught earlier on in relation to HIV diagnosis, participants stated that physical activity and goal setting would have been very useful due to helping with denial and confusion around HIV diagnosis. They stated that stress management and mindfulness, especially with relation to mindful eating, would have been useful. Participants also stated that self-care would have been very useful close to diagnosis, with one participant noting that after HIV diagnosis, "You get up every morning and you're like, 'Why would I take a shower?'" Participants agreed that if they had learned how to achieve greater levels of self-care

earlier in relation to diagnosis, they would have had an easier time. With regard to remembering your rights and how to communicate effectively, one woman stated, "If you haven't been exposed to these skills, you might be missing out on a lot – especially when you're first diagnosed," and "A lot of it comes back to how you got this disease, who you went to share it with. Staying positive with the disease can be a roller coaster."

Other modifications

Spirituality. When asked about whether incorporating spirituality into the sessions would be helpful for WLWH, participants answered affirmatively and noted that spirituality aligns well with self-care. One participated noted, "Even though you're living with HIV, you still need to take care of yourself. It's not the end of the world," when asked about where spirituality may fit in for WLWH.

Skills for communication with providers. Some women wanted more tools around effective communication with their doctors. After one woman brought up the idea that she had set a goal of better communication with her physician, other women noted that many of these skills could be used to improve patient/provider interactions and that it would be useful to incorporate this content more explicitly. However, this sentiment was not universal, as at least one woman felt that she was already very good at stating what she needed when speaking with her doctor.

Discussion

Overall Conclusions

A blended positive affect/communication skills/self-advocacy program appears to have merit for WLWH, and it appears to be worth exploring continued development of this program for WLWH. Women enjoyed learning the skills, felt as though they were helpful, and felt as

though other WLWH would find the skills useful. Importantly, women thought that skills learned in the current program would have been extremely useful more proximal to HIV diagnosis.

Lessons Learned

Leaders should have substantial prior training in clinical psychology/social work and running groups. This is important for teaching the skills in this context and for dealing with the intense trauma that many WLWH have experienced. In addition, there is going to be a group dynamic that develops over a series of group sessions, and whoever facilitates future groups must be aware of the group dynamics and how to skillfully navigate them, as comes with experience leading groups. A facilitator must feel comfortable taking control of the group and gently bring participants back when they get off subject or talk for long periods. In order to stop the group from going in less-than-ideal directions, facilitators may wish to consult with participants regarding a phrase or gesture that would gently remind women that they were going off subject and it was time to bring it back. For example, women in the current group believed that a facilitator could write "off subject" on the board, and point to it as a gentle reminder when necessary as long as subject matter is not emotionally charged. Future facilitators should be highly trained in running support groups so that they can easily keep participants on subject.

Future facilitators should consider ways to minimize distractions, such as a basket for all phones to go into so that women can be fully present throughout the sessions. They may also wish to consider asking participants to put their phones on silent once women enter the room, so that they can be fully present and engaged with program content.

If the group structure is retained, it may be useful to have an introductory version of the course that is four weeks long for one hour at a time. This would involve minimal commitment, and it may be possible to run more than one one-hour session. A shorter timeframe would allow

women on tight schedules to skill-building information. Subsequent to the introductory course, there could be an eight-week course with two hours each week, responding to women's desire to have more time and less content per session.

In addition, a workbook or online version of the program that taught the basics of the skills, then an additional group format in which participants could come together and talk about how they have or have not used the skills, would allow women to work at their own pace, learn the skills without distraction, and potentially benefit from the social support of a group.

Most women were interested in learning the skills and less interested in a support group that, to some, felt like group therapy. It is possible that discussing how the skills can be applied to real life situations could be beneficial. Women loved three breaths of arrival, felt that it was a very important component of self-care, and reported using this skill weekly. As such, it may make sense incorporate three breaths of arrival into every session and to link other concepts to it more explicitly. Some women wanted more tools around effective communication with their doctors. Thus, we should include this. In addition, expanding self-care, goal setting, and mindfulness content, potentially with some focus on spirituality, would allow content to be more attuned with what women believed were the most helpful skills.

It was clear throughout this program that food and drink create opportunities for community building and socializing. In the future, women could practice skills when eating or drinking beverages in the group. For example, mindfulness while sipping beverages during the soft start would allow women to have some buffer time before the new content begins. In addition, as sharing meals together appeared to be important to women, mindfully eating lunch together could be a beneficial component of the program. As mindful eating was not in the first session, the manual should be switched: Mindful eating should be part of the first session. In

addition to mindfully eating, it may also be useful to engage in the three breaths of arrival activity before participants eat. Building upon another skill, participants could talk about one thing they're grateful for before beginning to eat, and then begin their meals.

As the facilitator who led the group also handed out weekly self-report questionnaires, social desirability may have influenced ratings and feedback. In the future, the facilitator should not be present when questionnaires are being handed out or feedback is being given. Final questionnaires should also be relatively short, have larger areas for women to fill in answers, and should be created for a relatively low reading level, as some of the women had trouble understanding the language used in the feedback forms. One way to improve the amount of feedback received may be to have women take feedback questionnaires home after the last session with content, and bring them back for the feedback session. This way, women will have time to fill out questionnaires in their entirety, or at least look at questions previous to the feedback session. If women do not want to bring questionnaires back or aren't going to make it to the feedback session, they could take pictures of the filled out pages and text them back to study investigators. One other method of obtaining quantitative feedback that might be acceptable to women is via digital feedback: If women received short questionnaires via text message, similar to ecological momentary assessment of emotion, women could easily rate the utility of skills.

While most of the feedback we received is novel and provides a springboard for future research, some of what women stated is in line with previous research among WLWH. For example, in line with other work demonstrating increased social support among WLWH in a group intervention,[147] women greatly enjoyed the social support that they received from peers who were going through HIV-related stress. Women were also very receptive to the self-care

material. Importantly, WIHS cohort participants have noted in other research that they use self-care to improve and maintain their health,[27]. As women were receptive to both social support and self-care, researchers may want to explore other ways women can engage with the groups that make use of multiple skills. For example, it may make sense to examine the acceptability and feasibility of a walking group that would allow women to engage in self-care while building social connections and having camaraderie. In addition, women seemed to want to read out loud in front of peers with whom they were comfortable to improve their literacy skills. As such, future work may want to incorporate some literacy-building components into the program. As one participant really wanted a certificate of completion, this option should be explored in future groups. Importantly, it may be useful to have skill-building groups for recently-diagnosed WLWH.

Limitations

Limitations in the current study include the inability to collect data on participants, including age, race, and information on how the program affected the participants themselves. For example, we were unable to ask participants qualitatively or quantitatively whether the program was helpful for them personally. We were similarly unable to collect pre- and post-program data on positive affect, depression, spirituality, self-silencing, self-compassion, or self-care to examine where participants fell with regard to the general population or other WLWH, or whether participants exhibited changes over time in these domains.

Future Directions

Future research should test whether and how this program is beneficial to WLWH. Although this small proof-of-concept program showed high acceptability and women believed that it would be useful for other WLWH, this must be tested. In addition, given participants'

suggestions that learning these skills would have been useful more proximal to HIV diagnosis, this program should be tested in women more recently diagnosed with HIV. The current study builds upon previous research indicating that a positive affect intervention for people recently informed of their seropositive status in a mostly male sample is beneficial for mental health outcomes[29] by demonstrating that learning skills in a group format for WLWH is both feasible and acceptable.

In future research, the structure and length of positive affect, communication, and assertiveness programs should be further examined. While it is possible that having a short, introductory version of this program and a subsequent longer, more in-depth program would be useful, this must be empirically tested. As some women stated that they wanted to learn the skills rather than go to group therapy, it is possible than an online, self-guided version of this program may be beneficial.

Future researchers should test whether adding more mindfulness, goal setting, and self-care content is beneficial to women. Future programs should also have a larger number of women in them, and obtain data regarding preliminary efficacy of the program. In addition, understanding exactly which aspects of this program are beneficial to women should be examined. Perhaps programs such as this one will see success due to the particular skills taught, due to social support derived from going through a program together, or due to an aspect such as improving literacy skills or finding potential people to exercise with. With continued research, mechanisms regarding whether, how, and why positive affect regulation programs are helpful to women can be elucidated, and women can learn skills that may help them achieve better health.

Conclusion

Recap of studies

This set of studies aimed to address the gap in the literature regarding the predictive abilities of spirituality and positive affect by illuminating whether spirituality predicts viral load, immune function, and hypothalamus-pituitary-adrenal (HPA) axis activity, either via or independent of positive affect, among women in the Women's Interagency HIV Study (WIHS). They also aimed to examine the preliminary acceptability and feasibility of a positive emotion regulation program specifically among WLWH.

Study 1: In study 1, we examined whether spirituality was related to viral load among WHLIV participating in WIHS, and whether ART adherence and positive affect mediated this relationship. We hypothesized that spirituality would be related to lower viral load, and that positive affect and ART adherence would mediate this relationship.

Study 2: In study 2, we examined whether spirituality and/or positive affect were independently related to proinflammatory cytokines and immune markers including TNFRII, IL-6, CRP, cortisol, and also QOL in women with and without HIV. Our hypothesis was that spirituality would predict stress- and immune-related biomarkers and QOL independently of positive affect.

Study 3: In study 3, we assessed preliminary acceptability and feasibility of a positive affect skills program for WLWH**.** We tested the acceptability and feasibility of conducting a positive affect program for a group of WIHS participants and explored the extent to which spirituality played a role in acceptability of the program content. Our objective was to understand whether this program was both feasible and acceptable.

Major Findings

Study 1 Major Findings. In study 1, we found that there was a statistically significant relationship between higher spirituality and lower $\log_{10}$ viral load one year later, and that this relationship was mediated by adherence to ART. We found that although there was a relationship between spirituality and positive affect, there was no relationship between positive affect and viral load. This literature expands upon previous research indicating that spirituality is a motivator for WLWH adhere to ART among WLWH,[108] demonstrating that spirituality predicts adherence behavior and ultimately decreased viral load among WLWH. When results of the current study is taken with the WIHS study by Wilson et al., which demonstrated that that positive affect predicts virologic success, results suggest that positive affect may have more utility as a predictor of clinically relevant, dichotomized outcomes (e.g., viral load suppression) than as a predictor of continuous biological measurements in HIV.[32]

Study 2 Major Findings. In study 2, we found that higher positive affect predicted lower TNFRII, and there was no association between spirituality with TNFRII. Results provide preliminary evidence that positive affect is predictive of TNFRII in WLWH and demographically similar women, whereas spirituality is not. Neither spirituality nor positive affect independently predicted cortisol, IL-6, or CRP in a meaningful way. One measure of spirituality, the FACIT-Sp-12, and positive affect each independently predicted higher QOL. When examining whether another measure of spirituality, the IWSR, and PA independently predicted QOL, only positive affect showed predictive abilities. As the FACIT-Sp-12, but not the IWSR, and positive affect independently predicted QOL, it appears that some aspects of spiritualty and positive affect are important predictors of QOL in WLWH. Findings were robust between both WLWH and women living without HIV.

Study 3 Major Findings. In study 3, we found that a blended positive affect/communication skills/self-advocacy program appears to have merit for WLWH, and programs that provide psychological skill building exercises in group settings hold promise for WLWH. Women enjoyed learning the skills, felt as though they were helpful, and felt as though other WLWH would find the skills useful. Women also thought that skills learned in the current program would have been especially useful more proximal to HIV diagnosis.

Synthesis and Implications of Major Findings

This set of studies adds to the literature by demonstrating that two positive psychological constructs, spirituality and positive affect, predict healthy physiological and/or psychological outcomes for WLWH. Specifically, spirituality predicts lower viral load via increased ART adherence over time and higher QOL cross-sectionally. Positive affect predicts lower TNFRII and higher QOL cross-sectionally. Moreover, WLWH find a program intended to increase positive affect acceptable at a preliminary level.

These findings contribute to HIV research and clinical care by adding to a growing literature [e.g., 16,25,32,148-151] demonstrating that WLWH possess within themselves strengths that predict healthier biomarkers and psychological outcomes, and contribute to positive health psychology by further illuminating the link between mental health and physical health. Findings point to the potential benefit of caring for WLWH in a holistic manner. For example, rather than simply telling women to take their ART medications, it may be most useful to look upstream at factors that predict ART adherence, such as spirituality, and help women look at their spirituality as a strength that they can use to help them maintain high levels of adherence. Moreover, positive affect was predictive of lower TNFRII and both positive affect and spirituality were predictive of higher QOL among WLWH, and a small, pre-pilot program focused on bolstering

positive affect was deemed useful by women, who suggested that adding spirituality into the program would be useful. Aggregating these findings, it appears that WLWH are amenable to learning skills that predict healthier biomarkers and higher QOL. While further research is needed, results from the current studies suggest that incorporating discussions around spirituality and positive affect might be useful components of HIV clinical care for women.

Links with Theory

Revised Stress and Coping Theory. Revised Stress and Coping Theory posits that when people are faced with a situation they perceive as stressful, they can also experience positive psychological states which occur via three different pathways within the coping process.[60] On the first pathway, people use meaning-based processes to cope with the initial stressor. These meaning-based processes include, but are not limited to, engaging with spiritual beliefs. Secondly, when people are coping with the distress that the stressful situation is causing, meaning-based coping practices, including engaging with spiritual beliefs, can lead to increased positive emotion, which serves as a respite from the negative emotions they are experiencing. Lastly, the positive states can lead to renewed motivation to re-engage with a stressor, and can incite goal-oriented behavior.[60]

In Study 1, we tested part of the second pathway of Revised Stress and Coping Theory: that when people are coping with the distress that a stressful situation is causing, meaning-based coping practices, including engaging with spiritual beliefs, can lead to increased positive emotion. [60] Study 1 supported part of the second pathway of Revised Stress and Coping Theory, as results of this study indicated that spiritual beliefs predicted higher positive affect six months later among WLWH. We did not test Revised Stress and Coping Theory in Studies 2 and 3.

Broaden and Build Theory. According to the Broaden and Build Theory, in contrast to the narrowing of attention and inclination to fight or flee prompted by negative emotions, when one experiences positive emotional states, his or her repertoire of thoughts and potential actions is broadened, building psychological and social resources which may help individuals engage in more effective coping during stressful situations.[67]

In Study 2, we tested the Broaden and Build Theory by examining the relationships of spirituality and positive affect with QOL. Results of Study 2 supported the Broaden and Build Theory by demonstrating that higher spirituality, as measured with the FACIT-Sp-12 but not the IWSR, and positive affect, predicted increased QOL. In Study 3, we laid groundwork for testing the Broaden and Build Theory in the future by examining the acceptability and feasibility of a positive emotion regulation program for WLWH. Women indicated that skills included in this program would be useful, in part, because they would facilitate novel thoughts and actions (e.g., engaging in mental and physical self-care) among WLWH. Thus, while Study 3 preliminarily supports the Broaden and Build Theory, it also leaves room for this theory to be tested more completely in future iterations of this program.

Limitations

Retrospective measurement period (e.g., asking about positive affect over one week), the use of cross-sectional data, and having a very specific group of participants (i.e., a potential lack of generalizability) were limitations in the current set of studies. Taken together, limitations indicate that we may not have captured the full predictive abilities of positive psychological constructs, or potentially that results do not generalize beyond the current sample.

Future Directions

Capitalizing upon spirituality as a method by which to enhance adherence, and subsequently decrease viral load, may assist researchers, clinicians, and patients as they work toward the national HIV/AIDS goal of reaching 90% viral load suppression.[6] Future research must examine which facets of spirituality contribute to better physical and psychological health, and whether positive affect skills programs are efficacious in WLWH. Moreover, researchers and clinicians should examine whether discussing spirituality with WLWH during clinic visits improves QOL, immune and stress-related biomarkers, and viral load.

While this set of studies provides valuable information supporting the idea that spirituality and positive affect are physiologically and psychologically beneficial for WLWH, and that a positive emotion regulation program is acceptable and feasible for WLWH, there is more work to be done. We must continue to shine light on whether, how, and why positive psychological constructs are beneficial to WLWH so that members of this population can build their capacity to achieve their greatest levels of health. With continued research, it is possible that WLWH will be able to capitalize upon spirituality and positive affect even more than they currently are doing so as to lead healthier lives to age successfully with HIV.

Tables and Figures

Table 1-1

Descriptive Statistics

Measure	N	Range	M (SD)
IND SP	1387	2-48	38.66 (9.12)
FU SP	1391	2-48	39.23 (8.90)
IND ADH	1445	1-5	4.30 (0.85)
6mo ADH	1440	1-5	4.24 (0.89)
FU ADH	1403	1-5	4.28 (0.83)
IND PA	1520	4-16	13.38 (3.11)
6mo PA	1486	4-16	13.28 (3.20)
FU PA	1446	4-16	13.53 (3.07)
IND LogVL	1498	1-6	1.78 (1.02)
6mo LogVL	1444	1-6	1.69 (0.90)
FU LogVL	1437	1-6	1.70 (0.90)

Note. 6mo = six month; ADH = adherence, IND = Index, FU = Follow-up, LogVL = log10 viral load, PA = positive affect, SP = spirituality

Note. Adherence scale: 1 = I haven't taken any of my prescribed medications; 2 = <75% of the time; 3 = 75-94% of the time; 4 = 95-99% of the time; 5 = 100% of the time.

Table 1-2

Cross-Sectional and Longitudinal Bivariate Correlations between Variables of Interest

Measure	1	2	3	4	5	6	7	8	9	10	11
1. IND SP	1										
2. FU SP	.63**	1									
3. IND ADH	.64**	.48**	1								
4. 6mo ADH	.48**	.48**	0.54**	1							
5. FU ADH	.50**	.66**	0.54**	0.54**	1						
6. IND PA	.21**	.14**	0.14**	0.10**	0.15**	1					
7. 6mo PA	.15**	.11**	0.10**	0.13**	0.09**	0.45**	1				
8. FU PA	.18**	.22**	0.10**	0.11**	0.16**	0.49**	0.47**	1			
9. IND LogVL	-.10**	-0.04	-0.11**	-0.08**	-0.07*	-0.31**	-0.26**	-0.21**	1		
10. 6mo LogVL	-0.03	-0.03	-0.04	-0.04	-0.02	-0.23**	-0.39**	-0.27**	0.58**	1	
11. FU LogVL	-0.05	-.07*	-0.06*	-0.07*	-0.04	-0.24**	-0.29**	-0.33**	0.52**	0.62**	1

Note. ** $p < 0.01$; * $p < 0.05$.

Note. 6mo = six month; ADH = adherence, IND = Index, FU = Follow-up, LogVL = $\log_{10}$ viral load, PA = positive affect, SP = spirituality

Table 1-3

Satorra-Bentler Chi-Square Difference Tests between Direct Models, Partially Mediated Models, and Fully-Mediated Models

Mediator	Covariates	Models	X^2	df	*Diff. X^2 Model 1*	*Diff. X^2 Model 2*
Adherence	IND ADH, IND logVL	Model 1	1536.90	89	----	
		Model 2	1826.71	102	307.64*	----
		Model 3	1831.10	103	308.24*	1.26
	IND ADH, IND logVL, age, BMI, cohort, DEP, freqALC, PA, race, income	Model 1	3143.38	746	----	
		Model 2	3435.26	785	316.80*	----
		Model 3	3438.74	786	320.76*	3.07
PA	IND PA, IND logVL	Model 1	1856.58	133	----	
		Model 2	2207.95	205	296.13*	----
		Model 3	2211.35	206	297.23*	0.10
	IND PA, age, BMI, cohort, DEP, freqALC, IND logVL, race, income	Model 1	3308.57	714	----	
		Model 2	3938.38	874	617.30*	----
		Model 3	3939.64	875	618.40*	0.07

Note. Model 1 = Direct Model, Model 2 = Partially-Mediated Model, Model 3 = Fully-Mediated Model.
Note. BMI = body mass index; cohort = recruitment cohort within the WIHS study; DEP = depressive symptoms; freqALC = frequency of alcohol use over the past six month; IND ADH = adherence to ART at index; IND LogVL = index $\log_{10}$ viral load; IND PA = index positive affect; PA = positive affect.
Note. *p <0.001.

Table 1-4

Measures of Fit for Direct Model, Partially Mediated Mode, and Fully-Mediated Models

Mediator	Covariates	Models	X^2	RMSEA	CFI	SRMR
Adherence	IND ADH, IND logVL	Model 1	1536.90	0.109	0.730	0.090
		Model 2	1826.71	0.111	0.704	0.095
		Model 3	1831.10	0.111	0.704	0.095
	IND ADH, IND logVL, age, BMI, cohort, DEP, freqALC, PA, race, income	Model 1	3143.38	0.054	0.820	0.062
		Model 2	3435.26	0.055	0.807	0.063
		Model 3	3438.74	0.055	0.807	0.063
PA	IND PA, IND logVL	Model 1	1856.58	0.093	0.780	0.079
		Model 2	2207.95	0.080	0.796	0.076
		Model 3	2211.35	0.080	0.796	0.076
	IND PA, age, BMI, cohort, DEP, freqALC, IND logVL, race, income	Model 1	3309.86	0.055	0.823	0.059
		Model 2	3927.99	0.054	0.814	0.069
		Model 3	3929.28	0.054	0.814	0.069

Note. Model 1 = Direct Model, Model 2 = Partially-Mediated Model, Model 3 = Fully-Mediated Model.
Note. BMI = body mass index; cohort = recruitment cohort within the WIHS study; DEP = depressive symptoms; freqALC = frequency of alcohol use over the past six month; IND ADH = adherence to ART at index; IND logVL = index $\log_{10}$ viral load; IND PA = index positive affect; PA = positive affect.

Table 1-5

Path Analysis

Mediator	Covariates	Path	β	S.E.	Est./SE.	*p*-value
Adherence	IND ADH, IND logVL	SP on ADH	0.20**	0.03	6.69	0.00
		SP on logVL	0.03	0.03	1.12	0.26
		ADH on logVL	-0.25**	0.04	-5.61	0.00
	IND ADH, age, BMI, cohort, DEP, freqALC, IND logVL, PA, race, income	SP on ADH	0.22**	0.04	6.95	0.00
		SP on logVL	0.06	0.04	1.74	0.08
		ADH on logVL	-0.24**	0.05	-4.83	0.00
PA	BL PA, BL logVL	SP on PA	0.59**	0.03	22.27	0.00
		SP on logVL	0.00	0.05	0.059	0.95
		PA on logVL	-0.05	0.04	-1.45	0.15
	IND PA, age, BMI, cohort, DEP, freqALC, IND logVL, race, income	SP on PA	0.60**	0.03	20.57	0.00
		SP on logVL	-0.01	0.05	-0.18	0.86
		PA on logVL	-0.02	0.04	-0.37	0.71

Note. IND ADH = adherence to ART at index; IND logVL = index $\log_{10}$ viral load; IND PA = index positive affect; BMI = body mass index; cohort = recruitment cohort within the WIHS study; DEP = depressive symptoms; freqALC = frequency of alcohol use over the past six month; PA = positive affect. **p <0.001.

Table 2-1

Descriptive Statistics

Measure	N	Range	M (SD)
FACIT-Sp-12	252	13-50	38.49 (8.27)
IWSR	257	25-125	102.70 (18.48)
PA	274	0-12	8.91 (3.17)
usIL6	205	0.08-286.50	3.53 (20.27)
TNFRII	206	926.68-15024.60	2560.36 (1435.36)
usCRP	206	171.95-3939.24	1103.36 (618.67)
Cortisol	88	1.50-77.00	16.63 (14.04)
Urinary Creatinine	91	21.27-244.01	112.62 (59.12)
Log_{10} IL6	206	-1.11-2.46	0.04 (0.53)
Log_{10} TNFRII	207	2.97-4.18	3.36 (0.19)
Log_{10} CRP	207	2.24-3.60	2.98 (0.25)
Log_{10} Cortisol	88	0.18-1.89	1.07 (0.39)
Log_{10} Urinary Creatinine	91	21.27-244.01	112.62 (59.12)
QOL	266	2.5-100	68.64 (19.30)
Age	275	32-76	49.78 (8.80)

Table 2-2

Bivariate Correlations

	FACIT-Sp-12	IWSR	PA	Log_{10} IL6	Log_{10} TNFRII	Log_{10} CRP	Log_{10} Cortisol	Log_{10} UCr	QOL
FACIT-Sp-12	1								
IWSR	.40**	1							
PA	.47**	.19**	1						
Log_{10} IL6	-0.14	0.00	-0.06	1					
Log_{10} TNFRII	-0.08	-0.01	-.17*	.23**	1				
Log_{10} CRP	-0.0	-0.06	-0.08	-0.03	0.04	1			
Log_{10} Cortisol	-0.170	-0.12	0.13	-0.09	-0.13	0.09	1		
Log_{10} UCr	-0.05	-0.13	-0.20	-0.04	-.23*	0.14	0.05	1	
QOL	.36**	0.00	.34**	-0.11	-.15*	0.05	0.11	-0.12	1

Note. FACIT-Sp-12 = Functional Assessment of Chronic Illness Therapy; The 12-item Spiritual Well-Being Scale; IWSR = Ironson-Woods Spirituality/Religiousness Index; Log_{10} CRP = Log_{10} C-reactive protein; Log_{10} IL6 = Log_{10} interleukin-6; Log_{10} TNRII = Log_{10} tumor necrosis factor II; Log_{10} UCr = Log_{10} urinary creatinine; PA = positive affect; QOL = quality of life.
Note. $*p < 0.05$; $**p < 0.01$.

Table 2-3

Model Change for Multivariate Hierarchical Regressions with the FACIT-Sp-12 or IWSR and Positive Affect

Outcome	Predictors of Interest	Model	Predictors	R^2	*Adjusted* R^2	F Value	F Change
Log$_{10}$ Cortisol	FACIT-Sp-12 & PA	Model 1	UCr, FACIT-Sp-12, PA	0.08	0.05	2.44	2.44
		Model 2	UCr, FACIT-Sp-12, PA, Age, Race, Education	0.14	0.07	2.02	1.55
	IWSR & PA	Model 1	UCr, IWSR, PA	0.05	0.01	1.35	1.35
		Model 2	UCr, IWSR, PA, Age, Race, Education	0.09	0.02	1.30	1.24
Log$_{10}$ TNFRII	FACIT-Sp-12 & PA	Model 1	FACIT-Sp-12, PA	0.03	0.02	3.19*	3.19*
		Model 2	FACIT-Sp-12, PA, Age, Race, Education	0.08	0.05	3.02*	2.84*
	IWSR & PA	Model 1	IWSR, PA	0.03	0.02	3.46*	3.46*
		Model 2	IWSR, PA, Age, Race, Education	0.07	0.05	2.97*	2.60
Log$_{10}$ IL-6	FACIT-Sp-12 & PA	Model 1	FACIT-Sp-12, PA	0.02	0.01	1.88	1.88
		Model 2	FACIT-Sp-12, PA, Age, Race, Education	0.09	0.07	3.65*	4.76*
	IWSR & PA	Model 1	IWSR, PA	0.00	-0.01	0.41	0.41
		Model 2	IWSR, PA, Age, Race, Education	0.08	0.06	3.37*	5.32*
Log$_{10}$ CRP	FACIT-Sp-12 & PA	Model 1	FACIT-Sp-12, PA	0.00	-0.01	0.42	0.42
		Model 2	FACIT-Sp-12, PA, Age, Race, Education	0.01	-0.01	0.32	0.57
	IWSR & PA	Model 1	IWSR, PA	0.01	0.00	0.70	0.70
		Model 2	IWSR, PA, Age, Race, Education	0.02	0.00	0.85	0.33
QOL	FACIT-Sp-12 & PA	Model 1	FACIT-Sp-12, PA	0.17	0.16	25.30**	25.30**
		Model 2	FACIT-Sp-12, PA, Age, Race, Education	0.20	0.19	12.52*	3.49*
	IWSR & PA	Model 1	IWSR, PA	0.12	0.12	17.35**	17.35**
		Model 2	IWSR, PA, Age, Race, Education	0.16	0.14	8.97**	3.13*

Note. FACIT-Sp-12 = Functional Assessment of Chronic Illness Therapy; The 12-item Spiritual Well-Being Scale; IWSR = Ironson-Woods Spirituality/Religiousness Index; Log$_{10}$ CRP = Log$_{10}$ C-reactive protein; Log$_{10}$ IL6 = Log$_{10}$ interleukin-6; Log$_{10}$ TNRII = Log$_{10}$ tumor necrosis factor II; PA = positive affect; QOL = quality of life.

Note. F Change is change is F value from the previous step.
Note. *p <0.05, **p<0.001

Table 2-4

Multivariate Hierarchical Regressions with the FACIT-Sp-12 or IWSR and Positive Affect

Outcome	Predictors of Interest	Model	Predictors in Model	*B*	*SE B*	*B*
Log_{10} Cortisol	FACIT-Sp-12 & PA	Model 1	UCr	0.12	0.16	0.08
			FACIT-Sp-12	-0.01	0.01	-0.26*
			PA	0.03	0.01	0.25*
		Model 2	UCr	0.09	0.17	0.06
			FACIT-Sp-12	-0.01	0.01	-0.26*
			PA	0.03	0.01	0.27*
			Age	-0.01	0.00	-0.18
			Race	-0.20	0.16	-0.14
			Education	0.00	0.05	0.00
	IWSR & PA	Model 1	UCr	0.09	0.17	0.06
			IWSR	0.00	0.00	-0.16
			PA	0.02	0.01	0.19
		Model 2	UCr	0.07	0.17	0.05
			IWSR	0.00	0.00	-0.13
			PA	0.02	0.01	0.20
			Age	-0.01	0.00	-0.16
			Race	-0.18	0.16	-0.13
			Education	0.01	0.05	0.01
Log_{10} TNFRII	FACIT-Sp-12 & PA	Model 1	FACIT-Sp-12	0.00	0.00	-0.01
			PA	-0.01	0.00	-0.18*
		Model 2	FACIT-Sp-12	0.00	0.00	0.01
			PA	-0.01	0.00	-0.18*
			Age	0.00	0.00	0.18*
			Race	-0.05	0.04	-0.10
			Education	-0.01	0.01	-0.07
	IWSR & PA	Model 1	IWSR	0.00	0.00	0.02
			PA	-0.01	0.00	-0.19*
		Model 2	IWSR	0.00	0.00	0.04
			PA	-0.01	0.00	-0.19*
			Age	0.00	0.00	0.16*
			Race	-0.05	0.04	-0.10
			Education	-0.01	0.01	-0.06
Log_{10} IL-6	FACIT-Sp-12 & PA	Model 1	FACIT-Sp-12	-0.01	0.01	-0.14
			PA	0.00	0.01	0.00
		Model 2	FACIT-Sp-12	-0.01	0.01	-0.11
			PA	-0.01	0.01	-0.03
			Age	0.01	0.00	0.22**
			Race	-0.21	0.11	-0.13*
			Education	0.02	0.04	0.03

	IWSR & PA	Model 1	IWSR	0.00	0.00	0.01
			PA	-0.01	0.01	-0.07
		Model 2	IWSR	0.00	0.00	0.05
			PA	-0.02	0.01	-0.09
			Age	0.01	0.00	0.24**
			Race	-0.20	0.11	-0.13
			Education	0.02	0.04	0.03
Log$_{10}$ CRP	FACIT-Sp-12 & PA	Model 1	FACIT-Sp-12	0.00	0.00	0.01
			PA	-0.01	0.01	-0.07
		Model 2	FACIT-Sp-12	0.00	0.00	0.01
			PA	0.00	0.01	-0.06
			Age	0.00	0.00	0.03
			Race	0.05	0.05	0.07
			Education	-0.01	0.02	-0.05
	IWSR & PA	Model 1	IWSR	0.00	0.00	-0.06
			PA	0.00	0.01	-0.06
		Model 2	IWSR	0.00	0.00	-0.08
			PA	0.00	0.01	-0.04
			Age	0.00	0.00	0.02
			Race	0.07	0.05	0.10
			Education	-0.01	0.02	-0.05
QOL	FACIT-Sp-12 & PA	Model 1	FACIT-Sp-12	0.61	0.15	0.26**
			PA	1.35	0.40	0.22**
		Model 2	FACIT-Sp-12	0.62	0.15	0.27**
			PA	1.25	0.41	0.20**
			Age	-0.36	0.12	-0.17**
			Race	0.11	3.01	0.00
			Education	1.58	1.10	0.09
	IWSR & PA	Model 1	IWSR	-0.07	0.06	-0.07
			PA	2.20	0.37	0.36**
		Model 2	IWSR	-0.08	0.06	-0.08
			PA	2.19	0.38	0.35**
			Age	-0.38	0.13	-0.17**
			Race	1.13	3.14	0.02
			Education	0.80	1.13	0.04

Note. FACIT-Sp-12 = Functional Assessment of Chronic Illness Therapy; The 12-item Spiritual Well-Being Scale; IWSR = Ironson-Woods Spirituality/Religiousness Index; Log$_{10}$ CRP = Log$_{10}$ C-reactive protein; Log$_{10}$ IL6 = Log$_{10}$ interleukin-6; Log$_{10}$ TNRII = Log$_{10}$ tumor necrosis factor II; PA = positive affect; QOL = quality of life; UCr = urinary creatinine.
Note. *p <0.05, **p<0.001

Table 2-5

Moderation by HIV Status

Outcome	Model	Predictors	β	SE	p	95% CI
Log₁₀ Cortisol	Model 1	FACIT-Sp-12	0.01	0.02	0.80	-0.04, 0.05
		HIV Status	0.40	0.51	0.43	-0.62, 1.43
		FACIT-Sp-12* HIV Status	-0.01	0.01	0.53	-0.03, 0.02
		UCr	0.00	0.00	0.70	0.00, 0.00
	Model 2	IWSR	-0.02	0.01	0.10	-0.04, 0.00
		HIV Status	-0.71	0.58	0.23	-1.87, 0.45
		IWSR * HIV Status	0.01	0.01	0.16	0.00, 0.02
		UCr	0.00	0.00	0.67	0.00, 0.00
	Model 3	PA	0.00	0.06	0.97	-0.12, 0.12
		HIV Status	-0.05	0.41	0.91	-0.86, 0.77
		PA * HIV Status	0.01	0.03	0.72	-0.05, 0.08
		UCr	0.00	0.00	0.45	0.00, 0.00
Log₁₀ TNFRII	Model 1	FACIT-Sp-12	-0.01	0.01	0.12	-0.02, 0.00
		HIV Status	-0.12	0.15	0.42	-0.42, 0.18
		FACIT-Sp-12* HIV Status	0.01	0.00	0.14	0.00, 0.01
	Model 2	IWSR	0.00	0.00	0.85	-0.01, 0.01
		HIV Status	0.08	0.17	0.65	-0.26, 0.41
		IWSR * HIV Status	0.00	0.00	0.91	0.00, 0.00
	Model 3	PA	-0.03	0.02	0.15	-0.06, 0.01
		HIV Status	-0.04	0.13	0.76	-0.31, 0.22
		PA * HIV Status	0.01	0.01	0.33	-0.01, 0.03
Log₁₀ IL-6	Model 1	FACIT-Sp-12	0.00	0.02	0.93	-0.03, 0.03
		HIV Status	-0.05	0.38	0.89	-0.80, 0.70
		FACIT-Sp-12* HIV Status	0.00	0.01	0.96	-0.02, 0.02
	Model 2	IWSR	-0.01	0.01	0.41	-0.02, 0.01
		HIV Status	-0.53	0.45	0.25	-1.43, 0.38
		IWSR * HIV Status	0.00	0.00	0.32	0.00, 0.01
	Model 3	PA	-0.02	0.05	0.68	-0.11, 0.07
		HIV Status	-0.12	0.34	0.73	-0.79, 0.55
		PA * HIV Status	0.01	0.03	0.83	-0.04, 0.06

Log$_{10}$ CRP	Model 1	FACIT-Sp-12	0.00	0.01	0.88	-0.02, 0.02
		HIV Status	-0.05	0.21	0.80	-0.47, 0.37
		FACIT-Sp-12* HIV Status	0.00	0.01	0.97	-0.01, 0.01
	Model 2	IWSR	0.00	0.00	0.70	-0.01, 0.01
		HIV Status	0.08	0.24	0.73	-0.39, 0.55
		IWSR * HIV Status	0.00	0.00	0.55	-0.01, 0.00
	Model 3	PA	-0.03	0.02	0.25	-0.08, 0.02
		HIV Status	-0.21	0.18	0.25	-0.57, 0.15
		PA * HIV Status	0.01	0.01	0.37	-0.01, 0.04
QOL	Model 1	FACIT-Sp-12	0.75	0.62	0.23	-0.47, 1.98
		HIV Status	-3.52	13.93	0.80	-30.95, 23.90
		FACIT-Sp-12* HIV Status	0.05	0.34	0.89	-0.62, 0.72
	Model 2	IWSR	-0.09	0.28	0.75	-0.65, 0.47
		HIV Status	-10.22	16.09	0.53	-41.92, 21.48
		IWSR * HIV Status	0.06	0.16	0.72	-0.25, 0.36
	Model 3	PA	2.51	1.68	0.13	-0.79, 5.81
		HIV Status	-0.69	12.32	0.96	-24.94, 23.57
		PA * HIV Status	-0.31	0.91	0.74	-2.10, 1.49

Note. FACIT-Sp-12 = Functional Assessment of Chronic Illness Therapy; The 12-item Spiritual Well-Being Scale; IWSR = Ironson-Woods Spirituality/Religiousness Index; Log$_{10}$ CRP = Log$_{10}$ C-reactive protein; Log$_{10}$ IL6 = Log$_{10}$ interleukin-6; Log$_{10}$ TNRII = Log$_{10}$ tumor necrosis factor II; PA = positive affect; QOL = quality of life; UCr = urinary creatinine.

Table 3-1

Overview of Skills Taught, Goals with Rationale, and Weekly Homework

Session	Session Goal and Rationale	Daily Homework
Session 1: Mindfulness, Gratitude, & Kindness	**Rationale:** *Mindfulness.* Interventions intended to increase mindfulness have been shown to increase positive emotion.[152,153] Additionally, mindfulness practice has been associated with maintenance of CD4+ counts in in HIV positive study participants.[154] *Gratitude.* Intentionally noting that which for one is grateful is associated with increased well-being. [56-58] *Acts of Kindness.* Altruistic behaviors (i.e. acts of kindness such as volunteerism) have been associated with a decreased risk of mortality [65,66] and serious illness.[155]	Do one act of kindness and note how it made you feel. Practice mindfulness. Write down three good things that happened to you that day, or write down what/who you are grateful for.
Session 2: Mindfulness Part II, Self-Compassion & Personal Strengths	**Rationale:** *Mindfulness (Skill 4).* As noted above, mindfulness is associated with higher positive emotion.[59] *Self-Compassion.* Self-compassion, defined as being kind to oneself under conditions of difficulty rather than being critical, has been associated with decreased anxiety, increased well-being, and health-promoting behaviors.[156-158] *Focusing on Personal Strengths (Skill 6).* Thinking about one's positive qualities is associated with better psychological adjustment to illness[159] and healthier biological profiles.[160]	List a strength that you noticed about yourself and how you used it, practice self-compassion, and engage in a mindfulness exercise.
Session 3: Addressing Negative Thinking through Self-Care and Self-Compassion	**Rationale:** *Self-Compassion* As noted above, self-compassion is associated with helth-promoting behaviors and increased well-being, and decreased ill-being,[156-158] *Self-care.* Self-care, defined as engaging health-promoting behaviors, is positively associated with better health-related quality of life among WLWH.[158]	Work toward one self-care goal, get physical activity, practice self-compassion or a Lovingkindness mediation.
Session 4: Thinking and acting flexibly	**Rationale:** *Thinking and acting flexibly.* Interventions intended to increase emotional awareness, create flexibility in appraisals, identify and prevent behavioral and emotional avoidance, and promote interoception decrease negative affect, anxiety, and depression.[161]	Pause and take a breath before reacting when stressed, identify helpful thoughts and actions, practice known skills.
Session 5: Decreasing self-silencing, standing up for yourself, learning communication skills	**Rationale:** *Decreasing self-silencing.* Lower self-silencing, defined as silencing one's needs in interpersonal relationships, is associated with increased resilience.[16] *Standing up for yourself.* Therapies intended to increase assertiveness reduce depressive symptoms as compared to waitlist control groups.[162] *Communication skills.* Greater communication self-efficacy is associated with higher likelihood of consistent condom use among HIV-positive women.[163]	Create upward spirals of communication, stop downward spirals of communication, review an assertiveness bill of rights, and if it's safe, speak up for yourself. Practice known skills.
Session 6: Getting Active, Setting goals, and Overview	**Rationale:** *Physical activity.* Moderate, habitual physical activity is associated with higher likelihood of having higher positive affect,[164] and higher physical activity among people living with HIV is associated with lower viral load over time.[165] *Attainable goals (Skill 7).* Observational research on goals indicates that perceptions of goal progress are associated with greater life satisfaction and higher levels of positive emotion,[166,167] and pursuit of attainable goals (vs. more global distant goals) is associated with higher subjective well-being.[168]	Get physically active, set achievable goals, and practice known skills.
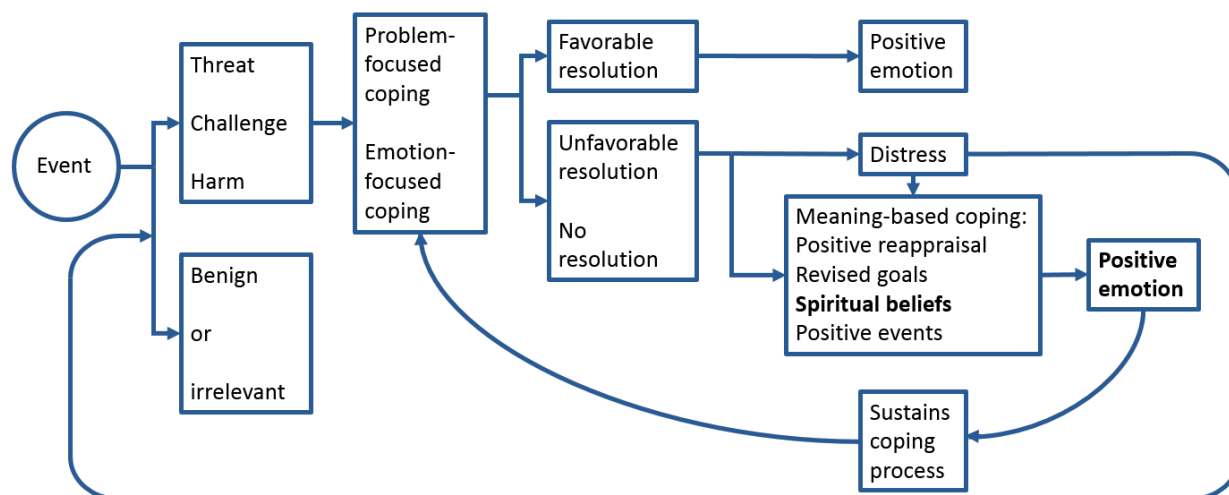
Figure 0-1. Visual representation of revised Stress and Coping Theory. From Folkman, 1997.[60]
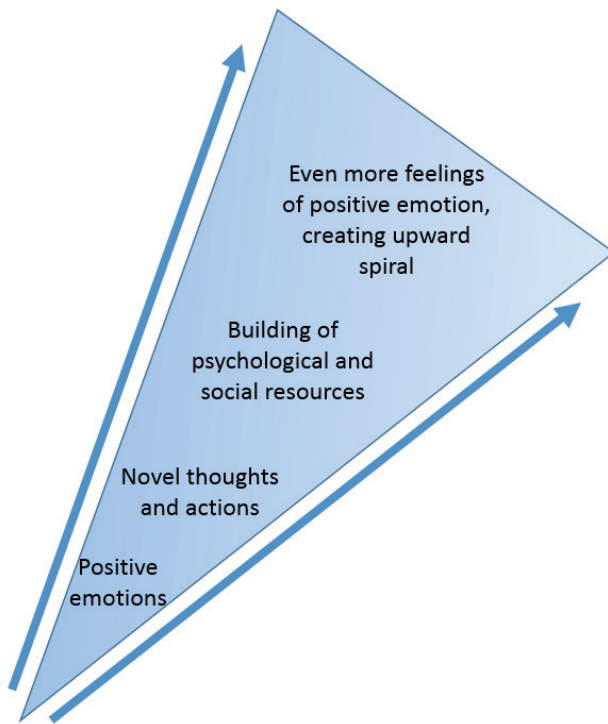
Figure 0-2. Visual representation of the Broaden and Build Theory. Adapted from Cohn & Fredrickson, 2009.[169]
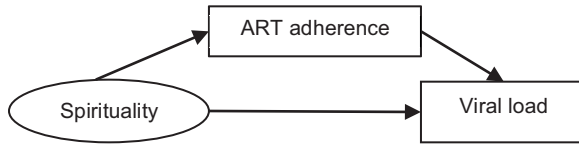
Figure 1-1. Hypothesized relationship between spirituality and viral load, as partially mediated by ART adherence.
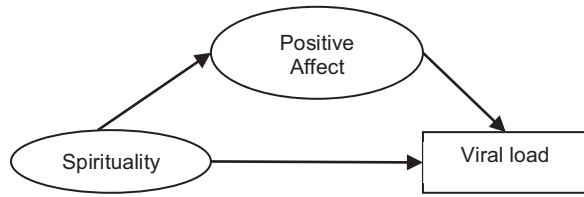
Figure 1-2. Hypothesized relationship between spirituality and viral load, as partially mediated by positive affect.
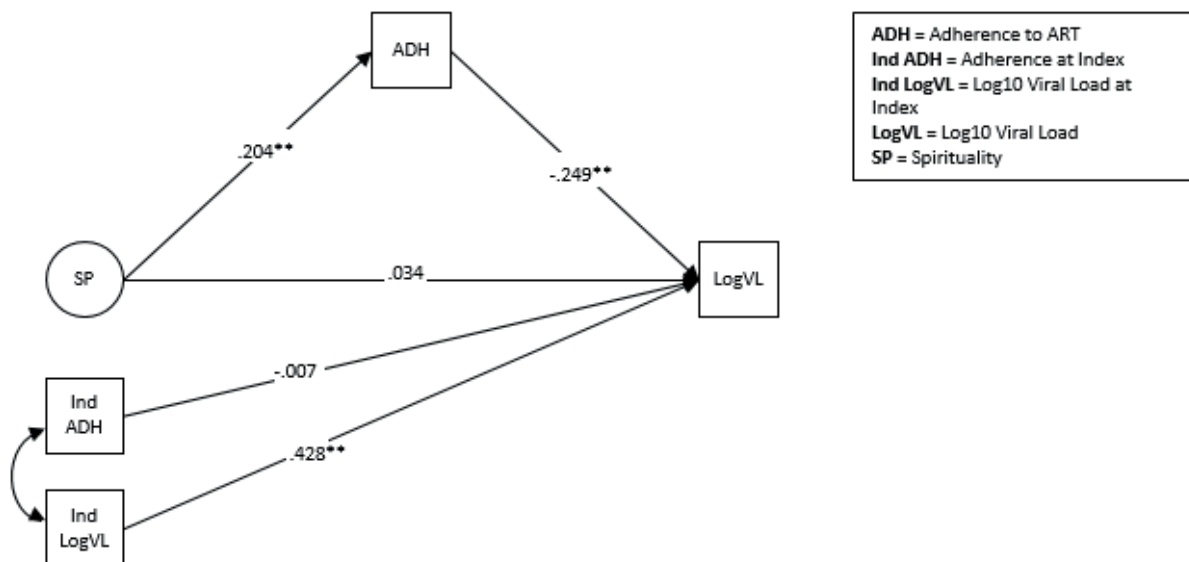
Figure 1-3. Pathways with STDYX standardized regression coefficients for model partially mediated by ART adherence, controlling for adherence to ART at index and $\log_{10}$ viral load at index. X^2 = 1826.71, RMSEA = 0.111, CFI = 0.704, SRMR = 0.095. **p <0.01.
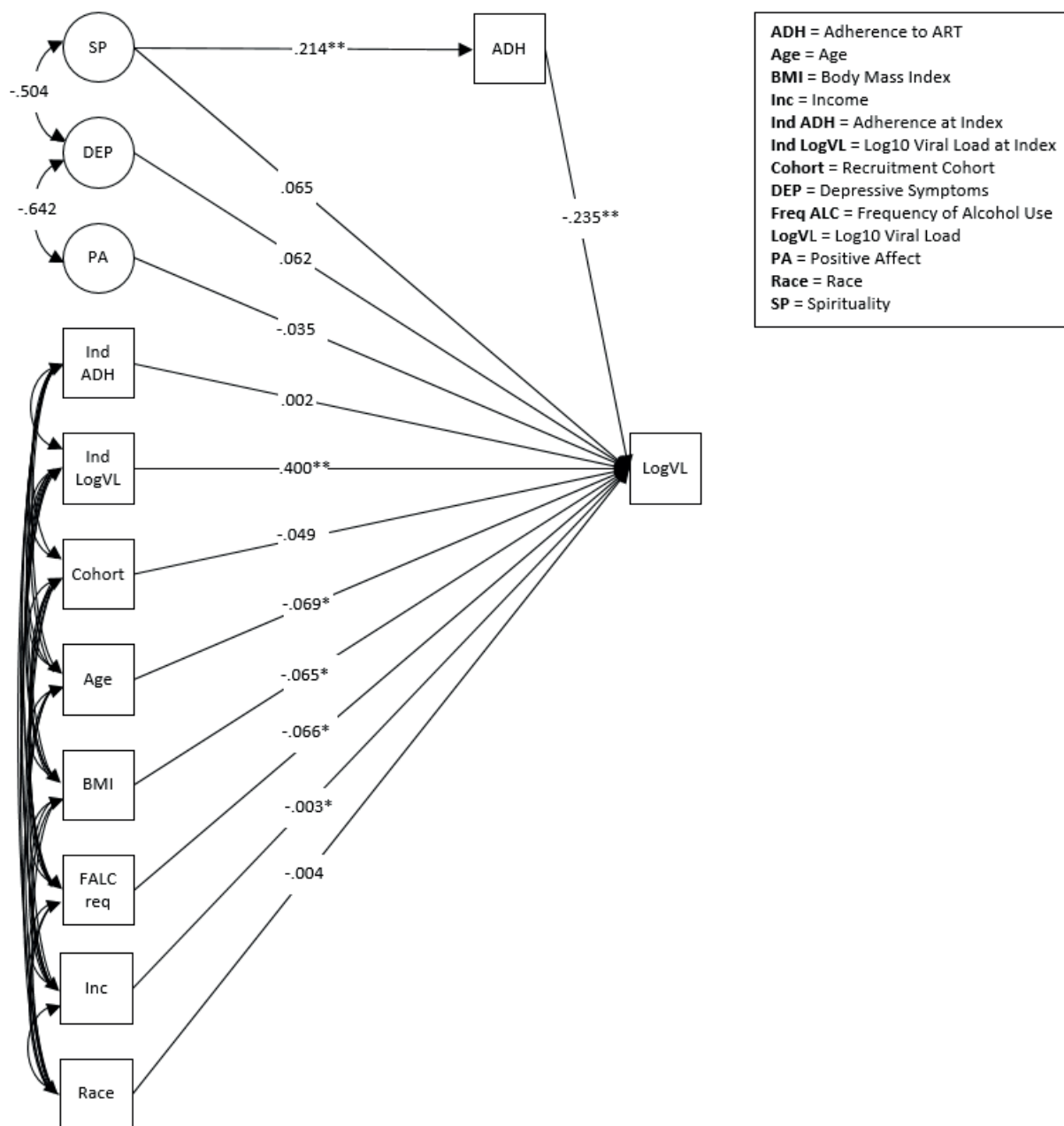
Figure 1-4. Pathways with STDYX standardized regression coefficients for model partially mediated by ART adherence, controlling for adherence to ART at index, viral load at index, depressive symptoms, positive affect, recruitment cohort within the WIHS study, age, BMI, and frequency of alcohol use. X^2 = 3425.941, RMSEA = 0.055, CFI = 0.809, SRMR = 0.062. **p <0.01, *p < 0.05.
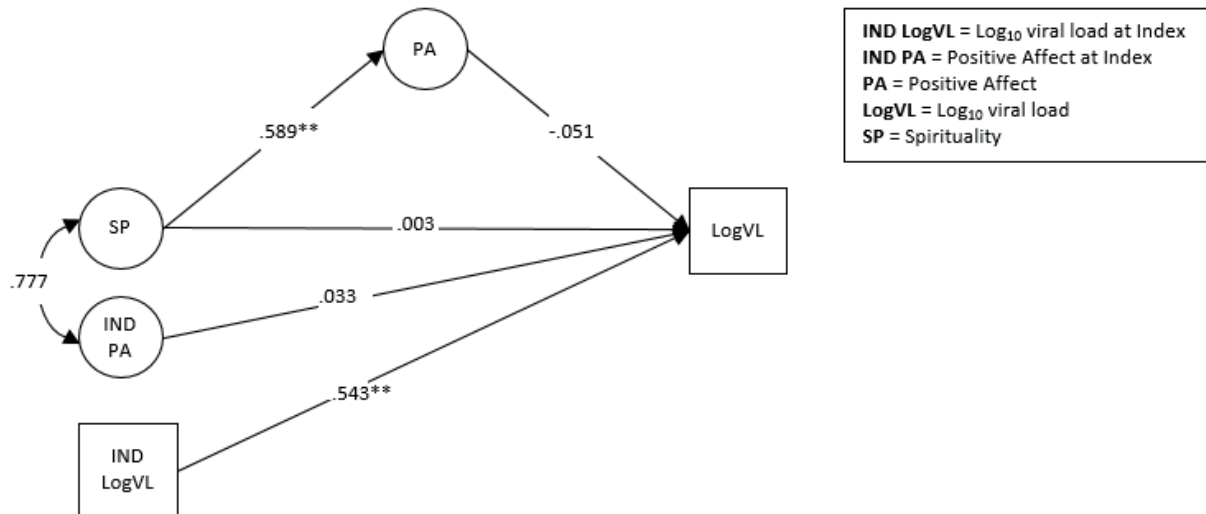
Figure 1-5. Pathways with STDYX standardized regression coefficients for model examining the relationship between spirituality and $\log_{10}$ viral load mediated by positive affect, controlling for index $\log_{10}$ viral load and index adherence to ART. X^2 = 2207.95, RMSEA = 0.080, CFI = 0.796, SRMR = 0.076. *p <0.01.
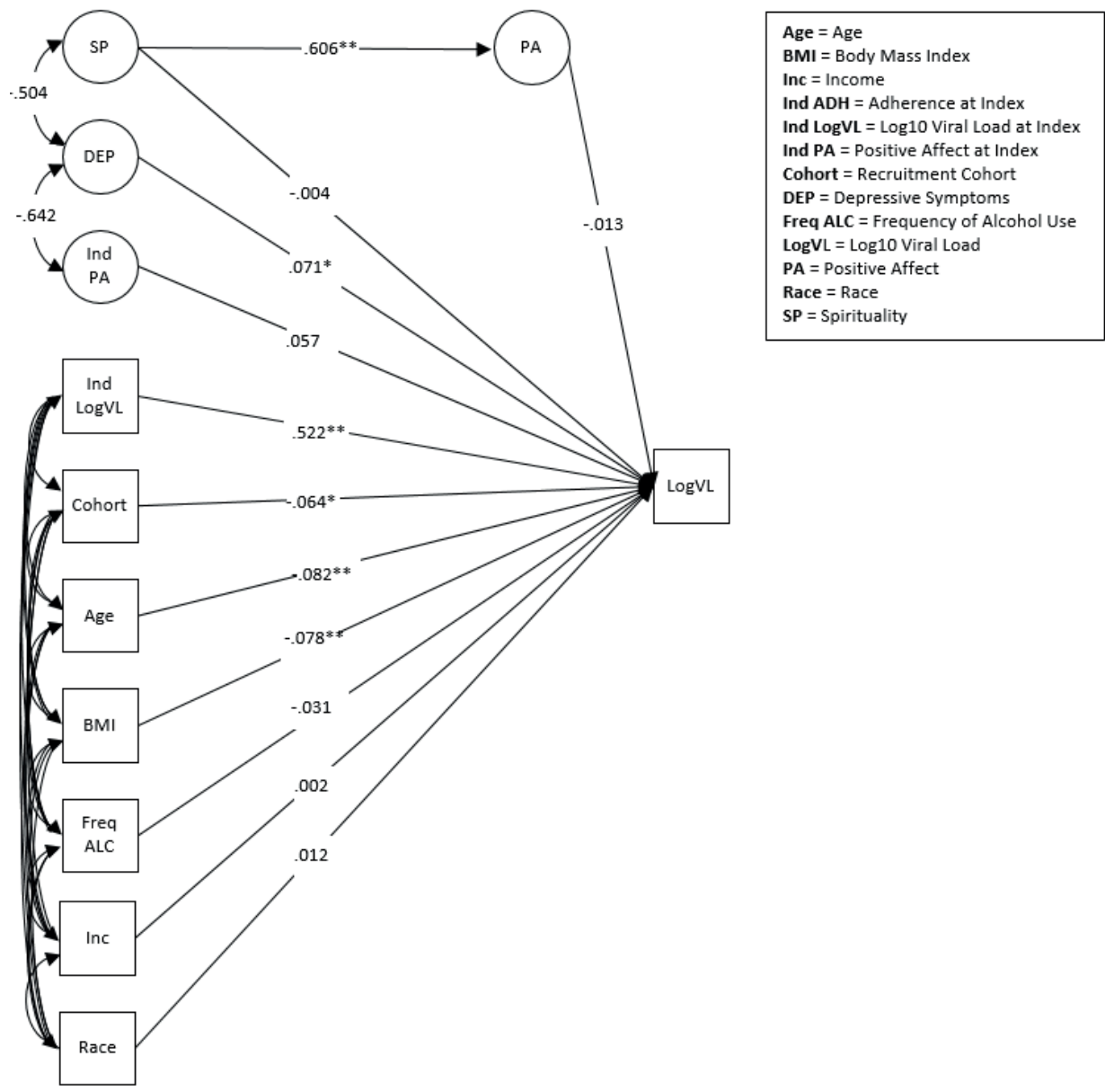
Figure 1-6. Pathways with STDYX standardized regression coefficients for model examining the relationship between spirituality and $\log_{10}$ viral load mediated by positive affect, controlling for $\log_{10}$ viral load at index, adherence to ART at index, cohort, age, BMI, depressive symptoms, and frequency of alcohol use. $X^2 = 3938.375$, RMSEA = 0.054, CFI = 0.815, SRMR = 0.069. **p <0.01, *p < 0.05.

References

1. Centers for Disease Control and Prevention. HIV Among Women. 2019; https://www.cdc.gov/hiv/group/gender/women/index.html. Accessed May 10, 2019.

2. Hess KL, Johnson SD, Hu X, et al. Diagnoses of HIV infection in the United States and dependent areas, 2017. 2018.

3. U.S. Department of Health & Human Services. HIV Care Continuum. HIV.gov2016.

4. Bodenlos JS, Grothe KB, Whitehead D, Konkle-Parker DJ, Jones GN, Brantley PJ. Attitudes toward health care providers and appointment attendance in HIV/AIDS patients. *Journal of the Association of Nurses in AIDS Care.* 2007;18(3):65-73.

5. Malcolm S, Ng J, Rosen R, Stone V. An examination of HIV/AIDS patients who have excellent adherence to HAART. *AIDS care.* 2003;15(2):251-261.

6. White House Office of National AIDS Policy. National HIV/AIDS Strategy for the United States: updated to 2020. 2015.

7. Loutfy MR, Sherr L, Sonnenberg-Schwan U, et al. Caring for women living with HIV: gaps in the evidence. *Journal of the International AIDS Society.* 2013;16(1):18509.

8. Decker MR, Benning L, Weber KM, et al. Physical and sexual violence predictors: 20 years of the women's interagency HIV study cohort. *American journal of preventive medicine.* 2016;51(5):731-742.

9. Machtinger EL, Wilson T, Haberer JE, Weiss DS. Psychological trauma and PTSD in HIV-positive women: a meta-analysis. *AIDS and Behavior.* 2012;16(8):2091-2100.

10. Anderson JC, Campbell JC, Glass NE, Decker MR, Perrin N, Farley J. Impact of intimate partner violence on clinic attendance, viral suppression and CD4 cell count of women living with HIV in an urban clinic setting. *AIDS care.* 2018;30(4):399-408.

11. Machtinger E, Haberer J, Wilson T, Weiss D. Recent trauma is associated with antiretroviral failure and HIV transmission risk behavior among HIV-positive women and female-identified transgenders. *AIDS and Behavior.* 2012;16(8):2160-2170.

12. Cohen M, Deamant C, Barkan S, et al. Domestic violence and childhood sexual abuse in HIV-infected women and women at risk for HIV. *American journal of public health.* 2000;90(4):560.

13. Markowitz SM, O'Cleirigh C, Hendriksen ES, Bullis JR, Stein M, Safren SA. Childhood sexual abuse and health risk behaviors in patients with HIV and a history of injection drug use. *AIDS and Behavior.* 2011;15(7):1554-1560.

14. Kelso GA, Cohen MH, Weber KM, Dale SK, Cruise RC, Brody LR. Critical consciousness, racial and gender discrimination, and HIV disease markers in African American women with HIV. *AIDS and Behavior.* 2014;18(7):1237-1246.

15. Rice WS, Turan B, Fletcher FE, et al. A mixed methods study of anticipated and experienced stigma in health care settings among women living with HIV in the United States. *AIDS patient care and STDs.* 2019;33(4):184-195.

16. Dale SK, Cohen MH, Kelso GA, et al. Resilience among women with HIV: Impact of silencing the self and socioeconomic factors. *Sex roles.* 2014;70(5-6):221-231.

17. Jacobs RJ, Thomlison B. Self-silencing and age as risk factors for sexually acquired HIV in midlife and older women. *Journal of Aging and Health.* 2009;21(1):102-128.

18. Brody LR, Stokes LR, Kelso GA, et al. Gender role behaviors of high affiliation and low self-silencing predict better adherence to antiretroviral therapy in women with HIV. *AIDS patient care and STDs.* 2014;28(9):459-461.

19. U.S. Department of Health & Human Services. Women's Health Issues. 2017; https://www.hiv.gov/hiv-basics/staying-in-hiv-care/other-related-health-issues/womens-health-issues. Accessed January 22, 2018.

20. Bing EG, Burnam MA, Longshore D, et al. Psychiatric disorders and drug use among human immunodeficiency virus–infected adults in the United States. *Archives of general psychiatry.* 2001;58(8):721-728.

21. Peterman AH, Fitchett G, Brady MJ, Hernandez L, Cella D. Measuring spiritual well-being in people with cancer: the functional assessment of chronic illness therapy—Spiritual Well-being Scale (FACIT-Sp). *Annals of behavioral medicine.* 2002;24(1):49-58.

22. Cotton S, Tsevat J, Szaflarski M, et al. Changes in religiousness and spirituality attributed to HIV/AIDS: Are there sex and race differences? *Journal of general internal medicine.* 2006;21(S5).

23. Ironson GH, Stuetzle R, Fletcher MA. An increase in religiousness/spirituality occurs after HIV diagnosis and predicts slower disease progression over 4 years in people with HIV. *Journal of general internal Medicine.* 2006;21(S5).

24. Ironson GH, Solomon GF, Balbin EG, et al. The Ironson-Woods Spirituality/Religiousness Index is associated with long survival, health behaviors, less distress, and low cortisol in people with HIV/AIDS. *Annals of Behavioral Medicine.* 2002;24(1):34-48.

25. Kremer H, Ironson G, Kaplan L, Stuetzele R, Baker N, Fletcher MA. Spiritual coping predicts CD4-cell preservation and undetectable viral load over four years. *AIDS care.* 2015;27(1):71-79.

26. Dalmida SG, Holstad MM, DiIorio C, Laderman G. The meaning and use of spirituality among African American women living with HIV/AIDS. *Western journal of nursing research.* 2012;34(6):736-765.

27. Brody LR, Jack DC, Bruck-Segal DL, et al. Life lessons from women with HIV: Mutuality, self-awareness, and self-efficacy. *AIDS patient care and STDs.* 2016;30(6):261-273.

28. Gonzalez A, Locicero B, Mahaffey B, Fleming C, Harris J, Vujanovic AA. Internalized HIV stigma and mindfulness: associations with PTSD symptom severity in trauma-exposed adults with HIV/AIDS. *Behavior modification.* 2016;40(1-2):144-163.

29. Moskowitz JT, Carrico AW, Duncan LG, et al. Randomized controlled trial of a positive affect intervention for people newly diagnosed with HIV. *Journal of consulting and clinical psychology.* 2017;85(5):409.

30. Moskowitz JT. Positive affect predicts lower risk of AIDS mortality. *Psychosomatic medicine.* 2003;65(4):620-626.

31. Carrico AW, Ironson G, Antoni MH, et al. A path model of the effects of spirituality on depressive symptoms and 24-hurinary-free cortisol in HIV-positive persons. *Journal of Psychosomatic Research.* 2006;61(1):51-58.

32. Wilson TE, Weedon J, Cohen MH, et al. Positive affect and its association with viral control among women with HIV infection. *Health Psychology.* 2017;36(1).

33. Carrico AW, Moskowitz JT. Positive affect promotes engagement in care after HIV diagnosis. *Health Psychology.* 2014;33(7):686.

34.   Leserman J, Petitto J, Gu H, et al. Progression to AIDS, a clinical AIDS condition and

        mortality: psychosocial and physiological predictors. *Psychological medicine.*

        2002;32(6):1059-1073.

35.   Dockray S, Steptoe A. Positive affect and psychobiological processes. *Neuroscience &*

        Biobehavioral Reviews. 2010;35(1):69-75.

36.   Sheng Y, Li F, Qin Z. TNF Receptor 2 Makes Tumor Necrosis Factor a Friend of

        Tumors. *Frontiers in Immunology.* 2018;9.

37.   Hernández-Ramírez RU, Shiels MS, Dubrow R, Engels EA. Cancer risk in HIV-infected

        people in the USA from 1996 to 2012: a population-based, registry-linkage study. *The*

        lancet HIV. 2017;4(11):e495-e504.

38.   Kumar A, Abbas W, Herbein G. TNF and TNF receptor superfamily members in HIV

        infection: new cellular targets for therapy? *Mediators of inflammation.* 2013;2013.

39.   Morlat P, Pereira E, Clayette P, et al. Early evolution of plasma soluble TNF-α p75

        receptor as a marker of progression in treated HIV-infected patients. *AIDS research and*

        human retroviruses. 2008;24(11):1383-1389.

40.   Tenorio AR, Zheng Y, Bosch RJ, et al. Soluble markers of inflammation and coagulation

        but not T-cell activation predict non–AIDS-defining morbid events during suppressive

        antiretroviral treatment. *The Journal of infectious diseases.* 2014;210(8):1248-1259.

41.   Drain PK, Kupka R, Msamanga GI, Urassa W, Mugusi F, Fawzi WW. C-reactive protein

        independently predicts HIV-related outcomes among women and children in a resource-

        poor setting. *AIDS (London, England).* 2007;21(15):2067.

42. Feldman JG, Goldwasser P, Holman S, DeHovitz J, Minkoff H. C-reactive protein is an independent predictor of mortality in women with HIV-1 infection. *JAIDS Journal of Acquired Immune Deficiency Syndromes.* 2003;32(2):210-214.

43. Triant VA, Meigs JB, Grinspoon SK. Association of C-reactive protein and HIV infection with acute myocardial infarction. *Journal of acquired immune deficiency syndromes (1999).* 2009;51(3):268.

44. Ai AL, Pargament K, Kronfol Z, Tice TN, Appel H. Pathways to postoperative hostility in cardiac patients: Mediation of coping, spiritual struggle and interleukin-6. *Journal of Health Psychology.* 2010;15(2):186-195.

45. Borges ÁH, O'connor JL, Phillips AN, et al. Factors associated with plasma IL-6 levels during HIV infection. *The Journal of infectious diseases.* 2015;212(4):585-595.

46. Janicki-Deverts D, Cohen S, Doyle WJ, Turner RB, Treanor JJ. Infection-induced proinflammatory cytokines are associated with decreases in positive affect, but not increases in negative affect. *Brain, behavior, and immunity.* 2007;21(3):301-307.

47. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *Journal of health and social behavior.* 1983:385-396.

48. Fumaz CR, Gonzalez-Garcia M, Borras X, et al. Psychological stress is associated with high levels of IL-6 in HIV-1 infected individuals on effective combined antiretroviral treatment. *Brain, Behavior, and Immunity.* 2012;26(4):568-572.

49. Brouwers C, Mommersteeg PM, Nyklíček I, et al. Positive affect dimensions and their association with inflammatory biomarkers in patients with chronic heart failure. *Biological psychology.* 2013;92(2):220-226.

50.   Cunningham WE, Crystal S, Bozzette S, Hays RD. The association of health-related quality of life with survival among persons with HIV infection in the United States. *Journal of general internal medicine.* 2005;20(1):21-27.

51.   Sawatzky R, Ratner PA, Chiu L. A meta-analysis of the relationship between spirituality and quality of life. *Social indicators research.* 2005;72(2):153-188.

52.   Murdaugh C. Health-related quality of life in HIV disease: achieving a balance. *Journal of the Association of Nurses in AIDS Care.* 1998;9(6):59-71.

53.   Murrell SA, Norris FH. Resources, life events, and changes in positive affect and depression in older adults. *American Journal of Community Psychology.* 1984;12(4):445-464.

54.   Zautra AJ, Reich JW. Life events and perceptions of life quality: Developments in a two? factor approach. *Journal of Community Psychology.* 1983;11(2):121-132.

55.   Langston CA. Capitalizing on and coping with daily-life events: Expressive responses to positive events. *Journal of Personality and Social Psychology.* 1994;67(6):1112.

56.   Emmons RA. *Thanks!: How the new science of gratitude can make you happier.* Houghton Mifflin Harcourt; 2007.

57.   Emmons RA, McCullough ME. Counting blessings versus burdens: an experimental investigation of gratitude and subjective well-being in daily life. *Journal of personality and social psychology.* 2003;84(2):377.

58.   Kashdan TB, Uswatte G, Julian T. Gratitude and hedonic and eudaimonic well-being in Vietnam war veterans. *Behaviour Research and Therapy.* 2006;44(2):177-199.

59.   Brown KW, Ryan RM. The benefits of being present: mindfulness and its role in psychological well-being. *Journal of personality and social psychology.* 2003;84(4):822.

60.   Folkman S. Positive psychological states and coping with severe stress. *Social science & medicine.* 1997;45(8):1207-1221.

61.   Sears SR, Stanton AL, Danoff-Burg S. The yellow brick road and the emerald city: benefit finding, positive reappraisal coping and posttraumatic growth in women with early-stage breast cancer. *Health Psychology.* 2003;22(5):487.

62.   Lazarus RS, Folkman S. *Stress, appraisal, and coping.* Springer publishing company; 1984.

63.   Carver CS, Scheier MF. Origins and functions of positive and negative affect: A control-process view. *Psychological review.* 1990;97(1):19.

64.   Lent RW, Singley D, Sheu HB, et al. Social cognitive predictors of domain and life satisfaction: Exploring the theoretical precursors of subjective well-being. *Journal of counseling psychology.* 2005;52(3):429.

65.   Musick MA, Wilson J. Volunteering and depression: The role of psychological and social resources in different age groups. *Social science & medicine.* 2003;56(2):259-269.

66.   Oman D, Thoresen CE, McMahon K. Volunteerism and mortality among the community-dwelling elderly. *Journal of Health Psychology.* 1999;4(3):301-316.

67.   Fredrickson BL. The broaden-and-build theory of positive emotions. *Philosophical Transactions of the Royal Society B: Biological Sciences.* 2004;359(1449):1367.

68.   Kuller LH, Tracy R, Belloso W, et al. Inflammatory and coagulation biomarkers and mortality in patients with HIV infection. *PLoS medicine.* 2008;5(10):e203.

69.   National Institute of Allergy and Infectious Diseases (NIAID). Women's Interagency HIV Study (WIHS). 2017; https://clinicaltrials.gov/ct2/show/NCT00000797. Accessed November 27, 2017.

70.   WIHS Data Management and Analysis Center. Women's Interagency HIV Study
        Dossier. 2017.

71.   Bacon MC, von Wyl V, Alden C, et al. The Women's Interagency HIV Study: an
        observational cohort brings clinical sciences to the bench. *Clinical and diagnostic
        laboratory immunology.* 2005;12(9):1013-1019.

72.   Moskowitz JT, Carrico AW, Cohn MA, et al. Randomized controlled trial of a positive
        affect intervention to reduce stress in people newly diagnosed with HIV; protocol and
        design for the IRISS study. *Open Access Journal of Clinical Trials.* 2014:85.

73.   Bassett SM, Cohn MA, Cotten P, Kwok I, Moskowitz JT. Feasibility and Acceptability of
        an Online Positive Affect Intervention for Those Living with Comorbid HIV Depression.
        AIDS and Behavior. 2019.

74.   Muthén L, Muthén B. Mplus. *The comprehensive modelling program for applied
        researchers: user's guide.* 2015;5.

75.   *IBM SPSS Statistics for Windows, Version 25.0* [computer program]. Armonk, NY: IBM
        Corp.; 2017.

76.   White House Office of National AIDS Policy. National HIV/AIDS Strategy for the
        United States: updated to 2020. 2015.

77.   Rubin LH, Springer G, Martin EM, et al. Elevated Depressive Symptoms Are a Stronger
        Predictor of Executive Dysfunction in HIV-Infected Women Than in Men. *JAIDS
        Journal of Acquired Immune Deficiency Syndromes.* 2019;81(3):274-283.

78.   Turan B, Rice WS, Crockett KB, et al. Longitudinal association between internalized
        HIV stigma and antiretroviral therapy adherence for women living with HIV: the
        mediating role of depression. *Aids.* 2019;33(3):571-576.

79. Bekhbat M, Mehta CC, Kelly SD, et al. HIV and symptoms of depression are independently associated with impaired glucocorticoid signaling. *Psychoneuroendocrinology.* 2018;96:118-125.

80. Park CL. Religiousness/spirituality and health: A meaning systems perspective. *Journal of behavioral medicine.* 2007;30(4):319-328.

81. Seybold KS. Physiological mechanisms involved in religiosity/spirituality and health. *Journal of behavioral medicine.* 2007;30(4):303-309.

82. Trevino KM, Pargament KI, Cotton S, et al. Religious coping and physiological, psychological, social, and spiritual outcomes in patients with HIV/AIDS: Cross-sectional and longitudinal findings. *AIDS and Behavior.* 2010;14(2):379-389.

83. Pargament KI, Smith BW, Koenig HG, Perez L. Patterns of positive and negative religious coping with major life stressors. *Journal for the scientific study of religion.* 1998:710-724.

84. Folkman S, Moskowitz JT. Positive affect and the other side of coping. *American Psychologist.* 2000;55(6):647-654.

85. Lyubomirsky S, Sheldon KM, Schkade D. Pursuing happiness: the architecture of sustainable change. *Review of general psychology.* 2005;9(2):111.

86. Konkle-Parker DJ, Erlen JA, Dubbert PM. Barriers and facilitators to medication adherence in a southern minority population with HIV disease. *Journal of the Association of Nurses in AIDS Care.* 2008;19(2):98-104.

87. Mannheimer S, Mukherjee R, Hirschhorn L, et al. The CASE adherence index: A novel method for measuring adherence to antiretroviral therapy. *AIDS care.* 2006;18(7):853-861.

88. Pecoraro A, Pacciolla A, O'Cleirigh C, et al. Proactive coping and spirituality among patients who left or remained in antiretroviral treatment in St Petersburg, Russian Federation. *AIDS care.* 2016;28(3):334-338.

89. Simoni JM, Frick PA, Huang B. A longitudinal evaluation of a social support model of medication adherence among HIV-positive men and women on antiretroviral therapy. *Health Psychology.* 2006;25(1):74.

90. Lorenz K, Hays RD, Shapiro MF, Cleary P, Asch SM, Wenger NS. Religiousness and spirituality among HIV-infected Americans. *Journal of Palliative Medicine.* 2005;8(4):774-781.

91. Radloff LS. The CES-D scale: A self-report depression scale for research in the general population. *Applied psychological measurement.* 1977;1(3):385-401.

92. Goodkin K, Shapshak P, Asthana D, et al. Older age and plasma viral load in HIV-1 infection. *Aids.* 2004;18:87-98.

93. Boodram B, Plankey MW, Cox C, et al. Prevalence and correlates of elevated body mass index among HIV-positive and HIV-negative women in the Women's Interagency HIV Study. *AIDS patient care and STDs.* 2009;23(12):1009-1016.

94. McFall AM, Dowdy DW, Zelaya CE, et al. Understanding the disparity: predictors of virologic failure in women using highly active antiretroviral therapy vary by race and/or ethnicity. *Journal of acquired immune deficiency syndromes (1999).* 2013;64(3).

95. Wu ES, Metzger DS, Lynch KG, Douglas SD. Association between alcohol use and HIV viral load. *Journal of acquired immune deficiency syndromes (1999).* 2011;56(5):e129.

96.   Gulick RM, Mellors JW, Havlir D, et al. Treatment with indinavir, zidovudine, and lamivudine in adults with human immunodeficiency virus infection and prior antiretroviral therapy. *New England Journal of Medicine.* 1997;337(11):734-739.

97.   Lifson AR, Krantz EM, Eberly LE, et al. Long-term CD4+ lymphocyte response following HAART initiation in a US Military prospective cohort. *AIDS research and therapy.* 2011;8(1):2.

98.   Pence BW, Mills JC, Bengtson AM, et al. Association of increased chronicity of depression with HIV appointment attendance, treatment failure, and mortality among HIV-infected adults in the United States. *JAMA psychiatry.* 2018;75(4):379-385.

99.   Schafer JL, Graham JW. Missing data: our view of the state of the art. *Psychological methods.* 2002;7(2):147.

100.   Huber PJ. Wiley series in probability and mathematics statistics. *Robust statistics.* 1981:309-312.

101.   Muthén LK, Muthén BO. Mplus Version 7 user's guide. *Los Angeles, CA: Muthén & Muthén.* 2012.

102.   Hu Lt, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural equation modeling: a multidisciplinary journal.* 1999;6:1-55.

103.   Bryant FB, Satorra A. Principles and practice of scaled difference chi-square testing. *Structural Equation Modeling: A Multidisciplinary Journal.* 2012;19(3):372-398.

104.   Fan X, Thompson B, Wang L. Effects of sample size, estimation methods, and model specification on structural equation modeling fit indexes. *Structural Equation Modeling: A Multidisciplinary Journal.* 1999;6(1):56-83.

105.   Kenny DA. Measuring model fit. 2015; http://davidakenny.net/cm/fit.htm. Accessed June

        6, 2019.

106.   Hu Lt, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis:

        Conventional criteria versus new alternatives. *Structural equation modeling: a*

        multidisciplinary journal. 1999;6(1):1-55.

107.   Lai K, Green SB. The problem with having two watches: Assessment of fit when

        RMSEA and CFI disagree. *Multivariate behavioral research.* 2016;51(2-3):220-239.

108.   Meredith KL, Jeffe DB, Mundy LM, Fraser VJ. Sources influencing patients in their HIV

        medication decisions. *Health education & behavior.* 2001;28(1):40-50.

109.   Health Resources and Services Administration. Performance Measure: HIV Viral Load

        Suppression. *HIV/AIDS Bureau Performance Measures* 2017;

        https://hab.hrsa.gov/sites/default/files/hab/clinical-quality-

        management/coremeasures.pdf. Accessed May 9, 2019.

110.   U.S. Department of Health & Human Services. Guidelines for the Use of Antiretroviral

        Agents in Adults and Adolescents with HIV. 2018;

        https://aidsinfo.nih.gov/guidelines/html/1/adult-and-adolescent-arv-

        guidelines/15/virologic-failure. Accessed May 9, 2019.

111.   Mattis JS, Jagers RJ. A relational framework for the study of religiosity and spirituality in

        the lives of African Americans. *Journal of Community Psychology.* 2001;29(5):519-539.

112.   Viswanathan S, Detels R, Mehta SH, Macatangay BJ, Kirk GD, Jacobson LP. Level of

        adherence and HIV RNA suppression in the current era of highly active antiretroviral

        therapy (HAART). *AIDS and Behavior.* 2015;19(4):601-611.

113. Shuter J, Sarlo JA, Kanmaz TJ, Rode RA, Zingman BS. HIV-infected patients receiving lopinavir/ritonavir-based antiretroviral therapy achieve high rates of virologic suppression despite adherence rates less than 95%. *JAIDS Journal of Acquired Immune Deficiency Syndromes.* 2007;45(1):4-8.

114. Addington EL, Cheung EO, Moskowitz JT. Positive affect skills may improve pain management in people with HIV. *Journal of health psychology.* 2018:1359105318769355.

115. MacLean CD, Susi B, Phifer N, et al. Patient preference for physician discussion and practice of spirituality: Results from a multicenter patient survey. *Journal of General Internal Medicine.* 2003;18(1):38-43.

116. Nieuwkerk PT, Oort FJ. Self-reported adherence to antiretroviral therapy for HIV-1 infection and virologic treatment response: a meta-analysis. *JAIDS Journal of Acquired Immune Deficiency Syndromes.* 2005;38(4):445-448.

117. Gandhi M, Ameli N, Bacchetti P, et al. Atazanavir concentration in hair is the strongest predictor of outcomes on antiretroviral therapy. *Clinical infectious diseases.* 2011;52(10):1267-1275.

118. Ironson G, O'cleirigh C, Fletcher MA, et al. Psychosocial factors predict CD4 and viral load change in men and women with human immunodeficiency virus in the era of highly active antiretroviral treatment. *Psychosomatic medicine.* 2005;67(6):1013.

119. Dray-Spira R, Lert F, Marimoutou C, Bouhnik A-D, Obadia Y. Socio-economic conditions, health status and employment among persons living with HIV/AIDS in France in 2001. *AIDS care.* 2003;15(6):739-748.

120. Carrico AW, Johnson MO, Moskowitz JT, et al. Affect regulation, stimulant use, and viral load among HIV-positive persons on anti-retroviral therapy. *Psychosomatic medicine.* 2007;69(8):785-792.

121. Del Giudice M, Gangestad SW. Rethinking IL-6 and CRP: Why they are more than inflammatory biomarkers, and why it matters. *Brain, behavior, and immunity.* 2018;70:61-75.

122. Bradley J. TNF-mediated inflammatory disease. *The Journal of Pathology: A Journal of the Pathological Society of Great Britain and Ireland.* 2008;214(2):149-160.

123. Shattuck EC, Muehlenbein MP. Religiosity/Spirituality and Physiological Markers of Health. *Journal of religion and health.* 2018:1-20.

124. Pressman SD, Cohen S. Does positive affect influence health? *Psychological bulletin.* 2005;131(6):925.

125. Bekelman DB, Parry C, Curlin FA, Yamashita TE, Fairclough DL, Wamboldt FS. A comparison of two spirituality instruments and their relationship with depression and quality of life in chronic heart failure. *Journal of Pain and Symptom Management.* 2010;39(3):515-526.

126. Corcuff JB, Tabarin A, Rashedi M, Duclos M, Roger P, Ducassou D. Overnight urinary free cortisol determination: a screening test for the diagnosis of Cushing's syndrome. *Clinical endocrinology.* 1998;48(4):503-508.

127. Bozzette SA, Hays RD, Berry SH, Kanouse DE, Wu AW. 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.* 1995;8(3):253-265.

128. Daynes R, Araneo B, Ershler W, Maloney C, Li G-Z, Ryu S-Y. Altered regulation of IL-6 production with normal aging. Possible linkage to the age-associated decline in dehydroepiandrosterone and its sulfated derivative. *The Journal of Immunology.* 1993;150(12):5219-5230.

129. Roubenoff R, Harris TB, Abad LW, Wilson PW, Dallal GE, Dinarello CA. Monocyte cytokine production in an elderly population: effect of age and inflammation. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences.* 1998;53(1):M20-M26.

130. Stangl A, Wamai N, Mermin J, Awor A, Bunnell R. Trends and predictors of quality of life among HIV-infected adults taking highly active antiretroviral therapy in rural Uganda. *AIDS care.* 2007;19(5):626-636.

131. Chapman BP, Khan A, Harper M, et al. Gender, race/ethnicity, personality, and interleukin-6 in urban primary care patients. *Brain, behavior, and immunity.* 2009;23(5):636-642.

132. Allison MA, Criqui MH, McClelland RL, et al. The effect of novel cardiovascular risk factors on the ethnic-specific odds for peripheral arterial disease in the Multi-Ethnic Study of Atherosclerosis (MESA). *Journal of the American College of Cardiology.* 2006;48(6):1190-1197.

133. Albert MA. Inflammatory biomarkers, race/ethnicity and cardiovascular disease. *Nutrition reviews.* 2007;65(suppl_3):S234-S238.

134. Steinvil A, Shirom A, Melamed S, et al. Relation of educational level to inflammation-sensitive biomarker level. *The American journal of cardiology.* 2008;102(8):1034-1039.

135.	Kapoor N, Job V, Jayaseelan L, Rajaratnam S. Spot urine cortisol–creatinine ratio–A useful screening test in the diagnosis of Cushing's syndrome. *Indian journal of endocrinology and metabolism.* 2012;16(Suppl 2):S376.

136.	Borges ÁH, O'Connor JL, Phillips AN, et al. Interleukin 6 is a stronger predictor of clinical events than high-sensitivity C-reactive protein or D-dimer during HIV infection. *The Journal of infectious diseases.* 2016;214(3):408-416.

137.	Noursadeghi M, Miller RF. Clinical value of C-reactive protein measurements in HIV-positive patients. *International journal of STD & AIDS.* 2005;16(6):438.

138.	Dale SK, Weber KM, Cohen MH, Brody LR. Abuse, nocturnal stress hormones, and coronary heart disease risk among women with HIV. *AIDS care.* 2017;29(5):598-602.

139.	French AL, Martin JW, Evans CT, et al. Macrophage Activation and the Tumor Necrosis Factor Cascade in Hepatitis C Disease Progression Among HIV-Infected Women Participating in the Women's Interagency HIV Study. *Journal of acquired immune deficiency syndromes (1999).* 2017;76(4):438-444.

140.	Steptoe A, O'donnell K, Badrick E, Kumari M, Marmot M. Neuroendocrine and inflammatory factors associated with positive affect in healthy men and women: the Whitehall II study. *American Journal of Epidemiology.* 2007;167(1):96-102.

141.	Dowling GA, Merrilees J, Mastick J, Chang VY, Hubbard E, Moskowitz JT. Life enhancing activities for family caregivers of people with frontotemporal dementia. *Alzheimer Disease & Associated Disorders.* 2014;28(2):175-181.

142.	Carrico AW, Gómez W, Siever MD, Discepola MV, Dilworth SE, Moskowitz JT. Pilot randomized controlled trial of an integrative intervention with methamphetamine-using men who have sex with men. *Archives of sexual behavior.* 2015;44(7):1861-1867.

143. Eller L, Rivero-Mendez M, Voss J, et al. Depressive symptoms, self-esteem, HIV symptom management self-efficacy and self-compassion in people living with HIV. *AIDS care.* 2014;26(7):795-803.

144. Gielen AC, McDonnell K, Wu AW, O'Campo P, Faden R. Quality of life among women living with HIV: the importance violence, social support, and self care behaviors. *Social science & medicine.* 2001;52(2):315-322.

145. Hall HI, Song R, Rhodes P, et al. Estimation of HIV incidence in the United States. *Jama.* 2008;300(5):520-529.

146. Brody LR, Stokes LR, Dale SK, et al. Gender roles and mental health in women with and at risk for HIV. *Psychology of women quarterly.* 2014;38(3):311-326.

147. Machtinger EL, Lavin SM, Hilliard S, et al. An expressive therapy group disclosure intervention for women living with HIV improves social support, self-efficacy, and the safety and quality of relationships: a qualitative analysis. *Journal of the Association of Nurses in AIDS Care.* 2015;26(2):187-198.

148. Dale SK. *Resilience, stress hormones, and health outcomes in women with HIV*, Boston University; 2014.

149. Dale SK, Cohen M, Weber K, Cruise R, Kelso G, Brody L. Abuse and resilience in relation to HAART medication adherence and HIV viral load among women with HIV in the United States. *AIDS patient care and STDs.* 2014;28(3):136-143.

150. Dale SK, Weber KM, Cohen MH, Kelso GA, Cruise RC, Brody LR. Resilience moderates the association between childhood sexual abuse and depressive symptoms among women with and at-risk for HIV. *AIDS and Behavior.* 2015;19(8):1379-1387.

151. Mistretta EG, Sloan D, BrintzenhofeSzoc K, Weber KM, Berger A. Testing domains of the healing experiences in all life stressors questionnaire in a cohort of HIV-infected and HIV-uninfected Chicago women. *Psychology research and behavior management.* 2017;10:201.

152. Fredrickson BL, Cohn MA, Coffey KA, Pek J, Finkel SM. Open hearts build lives: Positive emotions, induced through meditation, build consequential personal resources. *Journal of Personality and Social Psychology.* 2008;95:1045-1062.

153. Grossman P, Tiefenthaler-Gilmer U, Raysz A, Kesper U. Mindfulness training as an intervention for fibromyalgia: Evidence of postintervention and 3-year follow-up benefits in well-being. *Psychotherapy and Psychosomatics.* 2007;76:226-233.

154. Creswell JD, Myers HF, Cole SW, Irwin MR. Mindfulness meditation training effects on CD4+ T lymphocytes in HIV-1 infected adults: A small randomized controlled trial. *Brain, behavior, and immunity.* 2009;23(2):184-188.

155. Moen P, Dempster-McCain D, Williams RM. Successful Aging: A Life-Course Perspective on Women's Multiple Roles and Health. *American Journal of Sociology.* 1992;97(6):1612-1638.

156. Neff KD, Kirkpatrick KL, Rude SS. Self-compassion and adaptive psychological functioning. *Journal of research in personality.* 2007;41(1):139-154.

157. Neff KD. Self-compassion, self-esteem, and well-being. *Social and personality psychology compass.* 2011;5(1):1-12.

158. Sirois FM, Kitner R, Hirsch JK. Self-compassion, affect, and health-promoting behaviors. *Health Psychology.* 2015;34(6):661.

159. Taylor SE, Collins RL, Skokan LA, Aspinwall LG. Maintaining positive illusions in the face of negative information: Getting the facts without letting them get to you. *Journal of Social & Clinical Psychology.* 1989;8(2):114-129.

160. Taylor SE, Lerner JSS, D.K., Sage RM, McDowell NKl. Are self-enhancing cognitions associated with healthy or unhealthy biological profiles?. *Journal of Personality and Social Psychology.* 2003;85:605-615.

161. Ellard KK, Fairholme CP, Boisseau CL, Farchione TJ, Barlow DH. Unified protocol for the transdiagnostic treatment of emotional disorders: Protocol development and initial outcome data. *Cognitive and Behavioral Practice.* 2010;17(1):88-101.

162. Barth J, Munder T, Gerger H, et al. Comparative efficacy of seven psychotherapeutic interventions for patients with depression: a network meta-analysis. *Focus.* 2016;14(2):229-243.

163. Raiford JL, Wingood GM, DiClemente RJ. Correlates of consistent condom use among HIV-positive African American women. *Women & health.* 2007;46(2-3):41-58.

164. Pasco JA, Jacka FN, Williams LJ, Brennan SL, Leslie E, Berk M. Don't worry, be active: Positive affect and habitual physical activity. *Australian & New Zealand Journal of Psychiatry.* 2011;45(12):1047-1052.

165. Bopp CM, Phillips KD, Fulk LJ, Dudgeon WD, Sowell R, Hand GA. Physical activity and immunity in HIV-infected individuals. *AIDS care.* 2004;16(3):387-393.

166. Carver CS, Scheier MF. Origins and functions of positive and negative affect: A control process view. *Psychological Review.* 1990;97:19-35.

167.   Lent RW, Singley D, Sheu H-B, et al. Social cognitive predictors of domain and life satisfaction: Exploring the theoretical precursors of subjective well-being. *Journal of Consulting and Clinical Psychology.* 2005;52:429-442.

168.   Emmons RA. Abstract versus concrete goals: Personal striving level, physical illness, and psychological well-being. *Journal of Personality and Social Psychology.* 1992;62:292-300.

169.   Cohn MA, Fredrickson BL. Positive emotions. *Oxford handbook of positive psychology.* 2009;2:13-24.

170.   Johnson MO, Rose CD, Dilworth SE, Neilands TB. Advances in the conceptualization and measurement of Health Care Empowerment: development and validation of the Health Care Empowerment inventory. *PLoS One.* 2012;7(9):e45692.

Appendix A: Supplemental Analyses for Study 1 - Examining CD4+ Count

In Study 1, we examined whether the relationship between spirituality and viral load was mediated by positive affect or ART adherence. As results of Study 1 indicated that spirituality at index was associated with better adherence to ART at six months, which was in turn associated with lower $\log_{10}$ viral load at one year, we conducted exploratory analyses to examine whether adherence to ART mediated the relationship between spirituality and CD4+ count. In addition, we analyzed whether positive affect mediated this relationship. Methods mirrored those in the main paper, except that CD4+ was the outcome of interest rather than $\log_{10}$ viral load. See Figure A-1 and Figure A-2 for diagrams of hypothesized relationship between spirituality and CD4+ count, as partially mediated by adherence to ART and positive affect, respectively.

We first examined descriptive statistics (See Table A-1) and bivariate correlations (See Table A-2). Bivariate correlations indicated that spirituality at index was positively correlated with CD4+ count at one year ($r = 0.10$, $p < 0.01$). We then examined whether there was a relationship between spirituality and CD4+ count, mediated by either adherence to ART or positive affect using SEM in MPlus.[74] When examining adherence as a mediator, we were able to examine mediation in models in which index adherence and index CD4+ count were controlled for, and for models in which index adherence, index CD4+ count, age, BMI, cohort, frequency of alcohol use, race, and income were controlled for. However, models would not converge when adding in positive affect or depression as control variables. Thus, this set of analyses is best suited to an appendix. Partially-mediated models had best model fit. See Table A-3.

When examining positive affect as a mediator, we were able to control for index positive affect and index CD4+ count. However, when we added cohort, age, BMI, income, race (dummy

coded as white vs non-white), and frequency of alcohol use, model comparisons indicated that the direct effect model, rather than the partially-mediated model was the best fitting model to employ. Due to a lack of interpretability when comparing the partially-mediated with fewer covariates with the more greatly controlled direct effect model, and therefore a lack of ability to draw accurate conclusions, we only include the model controlling for index positive affect and index CD4+ count in the current manuscript. Again, models would not converge when adding depressive symptoms as a covariate.

We assessed model fit the same way as we did for viral load: using root mean square error of approximations (RMSEAs), comparative fit indices (CFIs), and Standardized Root Mean Square Residuals (SRMRs). CFIs are incremental measures of fit, and are analogous to R^2.[102,105] CFIs at or above 0.95 indicate good fit.[106,107] Similar to model fit for viral load analyses, CFIs were less than 0.90. RMSEAs are absolute measures of fit. Absolute measures of fit assume that the model that fits the data best has a fit of zero. Therefore, the closer the RMSEA is to zero, the better the fit.[105] RMSEAs of less than 0.05 or 0.06 indicate good fit, and RMSEAs between 0.05 and 0.10 indicate acceptable fit.[106,107] RMSEAs were between 0.09 and 0.11 for all analyses, indicating acceptable to poor model fit. Like RMSEAs, SRMRs are absolute measures of fit.[105] SRMRs of less than 0.08 indicate good fit.[106,107] SRMRs were greater than 0.08 in analyses controlling only for index positive affect and index CD4+ or index positive affect and index $\log_{10}$ CD4. Thus, results of these analyses should be interpreted with caution. SRMRs were less than 0.08 for analyses examining adherence as a mediator of the relationship between spirituality and CD4+ count, controlling for a greater number of covariates, which indicates acceptable model fit. However, as the RMSEA for this model still fell above 0.08, caution should be taken when interpreting results. See Table A-4.

When examining the relationship between spirituality and CD4+ count as partially mediated by adherence to ART over the past six months, we found that while there was no direct relationship between spirituality and CD4+ in the model only controlling for index adherence and index CD4+ count ($\beta = 0.01$, $p = 0.73$), greater spirituality at index was related to higher ART adherence ($\beta = 0.20$, $p < 0.01$), which, in turn, predicted CD4+ at one year ($\beta = 0.05$, $p < 0.01$). In the fully controlled model, there was, again, no direct relationship between spirituality and CD4+ count one year later ($\beta = 0.02$, $p = 0.39$). While spirituality was related to greater adherence six months later ($\beta = 0.21$, $p < 0.01$), adherence was not significantly related to higher CD4+ count at one year ($\beta = 0.04$, $p = 0.08$).

When examining the relationship between spirituality and $\log_{10}$ viral load as partially mediated by positive affect at six months, we found that there was no direct relationship between spirituality and viral load one year later ($\beta = 0.03$, $p = 0.27$) in the model only controlling for index adherence and index CD4+ count. Although greater spirituality led to higher positive affect six months later ($\beta = 0.61$, $p < 0.01$), positive affect at six months did not predict CD4+at one year ($\beta = 0.01$, $p = 0.63$). See Table A-5 for more detail. See Figures A-3 through A-5 for path analysis diagrams with STDYX standardized regression coefficients for the separate models examining 1) the relationship between spirituality and CD4+ count mediated by adherence when controlling only for adherence to ART at index and CD4+ count at index 2) the relationship between spirituality and CD4+ count mediated by adherence when controlling for adherence to ART at index, CD4+ count at index, recruitment cohort, age, BMI, frequency of alcohol use, income, and race, and 3) the relationship between spirituality and CD4+ count mediated by positive affect when controlling for positive affect at index and CD4+ count at index.

Results from these analyses indicate that there is a no relationship between spirituality and CD4+ count mediated by either adherence to ART or by positive affect. If it is possible to help women capitalize upon their spirituality, as discussed in the main paper, WLWH may look forward to lower viral loads, but this benefit does not appear to extend to CD4+ counts.

Table A-1

Descriptive Statistics

Measure	N	Range	M (SD)
IND SP	1387	2-49	39.25 (8.91)
FU SP	1391	2-50	13.53 (3.06)
IND ADH	1445	1-5	1.76 (1.71)
6mo ADH	1440	1-5	4.24 (0.89)
FU ADH	1403	1-5	4.28 (0.83)
IND PA	1520	4-16	13.38 (3.11)
6mo PA	1486	4-16	13.28 (3.20)
FU PA	1446	4-16	13.53 (3.07)
IND CD4	1513	1-3	2.73 (0.30)
6mo CD4	1462	0-3	2.75 (0.29)
FU CD4	1442	0-3	2.75 (0.28)

Note. 6mo = six month; ADH = adherence, IND = Index, FU = Follow-up, CD4+ = CD4+ count, PA = positive affect, SP = spirituality

Table A-2

Cross-Sectional and Longitudinal Bivariate Correlations between Variables of Interest

Measure	1	2	3	4	5	6	7	8	9	10	11
1. IND SP	1										
2. FU SP	0.63**	1									
3. IND ADH	0.21**	0.14**	1								
4. 6mo ADH	0.15**	0.11**	0.45**	1							
5. FU ADH	0.18**	0.22**	0.49**	0.47**	1						
6. IND PA	0.64**	0.48**	0.14**	0.10**	0.10**	1					
7. 6mo PA	0.48**	0.48**	0.10**	0.13**	0.11**	0.54**	1				
8. FU PA	0.50**	0.66**	0.15**	0.09**	0.16**	0.54**	0.54**	1			
9. IND CD4+	0.09**	0.07*	0.21**	0.19**	0.19**	0.07**	0.05	0.08**	1		
10. 6mo CD4+	0.08**	0.07*	0.20**	0.22**	0.21**	0.06*	0.05	0.09**	0.89**	1	
11. FU CD4+	0.10**	0.09**	0.20**	0.22**	0.21**	0.07**	0.06*	0.09**	0.85**	0.89**	1

Note. 6mo = six month; ADH = adherence, IND = Index, FU = Follow-up, CD4+ = CD4+ count,
PA = positive affect, SP = Spirituality
Note. ** $p < 0.01$; * $p < 0.05$.

Table A-3

Satorra-Bentler Chi-Square Difference Tests between Direct Models, Partially Mediated Models, and Fully-Mediated Models

Mediator	Covariates	Models	X^2	df	Diff. X^2 Model 1	Diff. X^2 Model 2
Adherence	IND ADH, IND CD4+	Model 1	1534.90	89	----	
		Model 2	1816.77	102	294.45**	----
		Model 3	1822.541	103	298.24**	0.13
	IND ADH, IND CD4+, age, BMI, cohort, freqALC, race, income	Model 1	1703.36	161	----	
		Model 2	1971.28	180	393.92**	----
		Model 3	1973.91	181	396.44**	0.59
PA	IND PA, IND CD4+	Model 1	1828.70	133	----	
		Model 2	2463.69	205	610.81**	----
		Model 3	2467.16	206	613.15**	1.23

Note. Model 1 = Direct Model, Model 2 = Partially-Mediated Model, Model 3 = Fully-Mediated Model.

Note. BMI = body mass index; cohort = recruitment cohort within the WIHS study; freqALC = frequency of alcohol use over the past six month; IND ADH = adherence to ART at index; IND CD4+ = index CD4+ count; IND PA = index positive affect; PA = positive affect.

Note. **$p < 0.01$.

Table A-4

Measures of Fit for Direct Model, Partially Mediated Mode, and Fully-Mediated Models

| Mediator	Covariates	Models	X^2	RMSEA	CFI	SRMR
Adherence	IND ADH, IND CD4+	Model 1	1534.90	0.109	0.765	0.084
		Model 2	1816.77	0.110	0.741	0.091
		Model 3	1822.54	0.110	0.740	0.091
	IND ADH, IND CD4+, age, BMI, cohort, freqALC, race, income	Model 1	1727.85	0.093	0.762	0.071
		Model 2	2105.70	0.097	0.726	0.079
		Model 3	2108.24	0.097	0.726	0.080
PA	IND PA, IND CD4+	Model 1	1828.70	0.092	0.803	0.078
		Model 2	2463.69	0.085	0.793	0.082
		Model 3	2467.16	0.085	0.793	0.083

Note. Model 1 = Direct Model, Model 2 = Partially-Mediated Model, Model 3 = Fully-Mediated Model. *Note.* BMI = body mass index; cohort = recruitment cohort within the WIHS study; freqALC = frequency of alcohol use over the past six month; IND ADH = adherence to ART at index; IND CD4+ = index CD4+ count; IND PA = index positive affect; PA = positive affect.

Table A-5

Path Analysis

Mediator	Covariates	Path	β	S.E.	Est./SE.	*p*-value
Adherence	IND ADH, IND CD4+	SP on ADH	0.20	0.03	6.70	0
		SP on CD4+	0.01	0.02	0.35	0.73
		ADH on CD4+	0.05	0.02	2.64	0.01
	IND ADH, age, BMI, cohort, freqALC, IND CD4+, race, income	SP on ADH	0.21	0.03	6.61	0
		SP on CD4+	0.02	0.02	0.89	0.39
		ADH on CD4+	0.04	0.02	1.76	0.08
PA	IND PA, IND CD4+	SP on PA	0.61	0.03	23.17	0
		SP on CD4+	0.03	0.03	1.10	0.27
		PA on CD4+	0.01	0.03	0.49	0.63

Note. IND ADH = adherence to ART at index; CD4 = CD4+ count; IND CD4+ = index CD4+ count; IND PA = index positive affect; BMI = body mass index; cohort = recruitment cohort within the WIHS study; freqALC = frequency of alcohol use over the past six month; PA = positive affect.
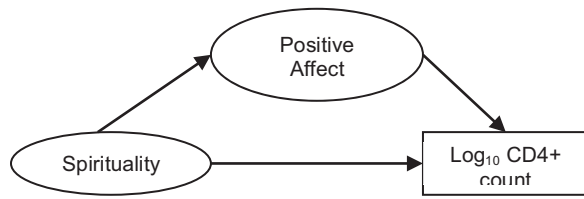
Figure A-1. Hypothesized relationship between spirituality and CD4+ count, as partially mediated by positive affect.
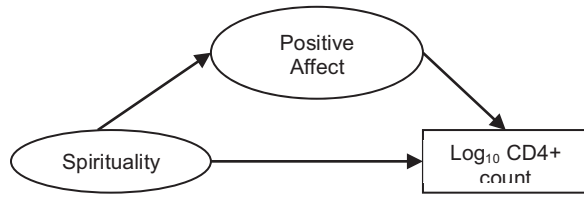
Figure A-2. Hypothesized relationship between spirituality and CD4+ count, as partially mediated by positive affect.

Figure A-3. Pathways with STDYX standardized regression coefficients for model partially mediated by ART adherence, controlling for adherence to ART at index and CD4+ count at index. $X^2 = 1816.77$, RMSEA = 0.110, CFI = 0.741, SRMR = 0.091. **p <0.01, *p < 0.05.
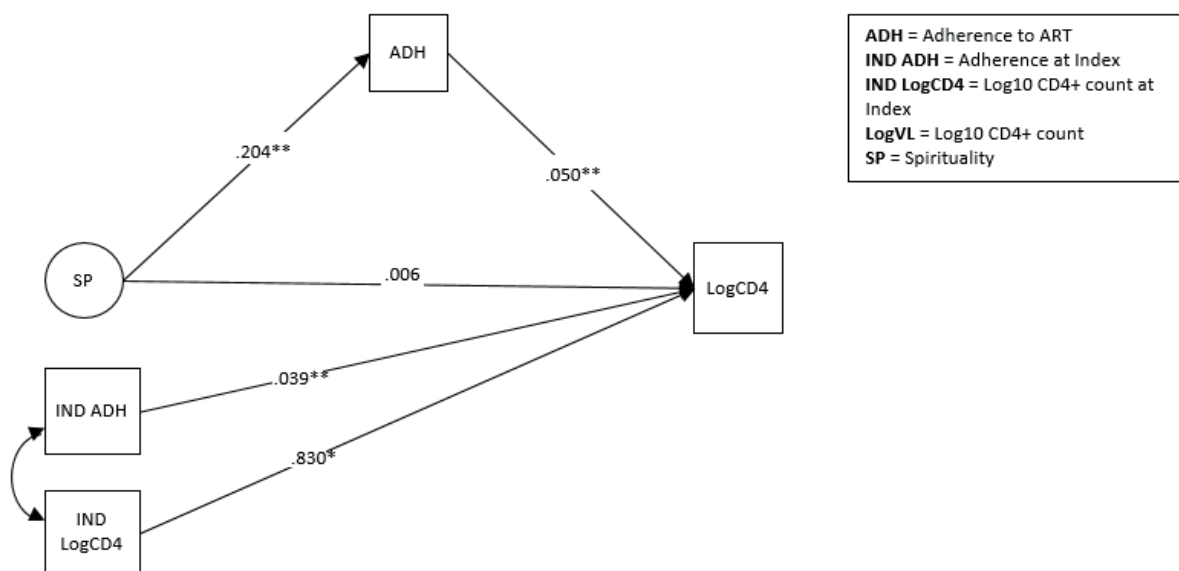
Figure A-4. Pathways with STDYX standardized regression coefficients for model partially mediated by ART adherence, controlling for adherence to ART at index, CD4+ count at index, recruitment cohort, age, BMI, frequency of alcohol use, income, and race. $X^2 = 1971.28$, RMSEA = 0.094, CFI = 0.740, SRMR = 0.076. **p <0.01, *p < 0.05.
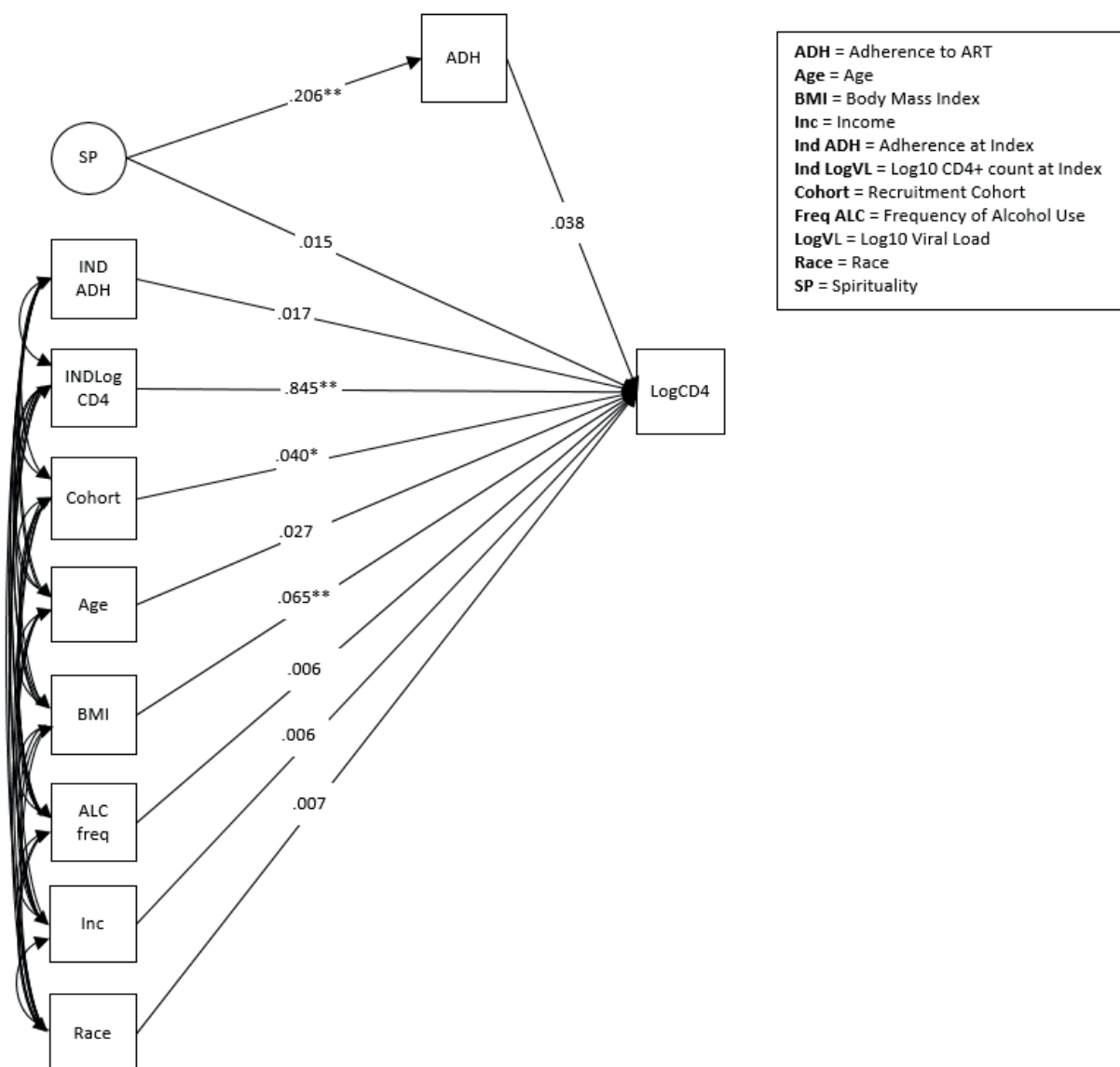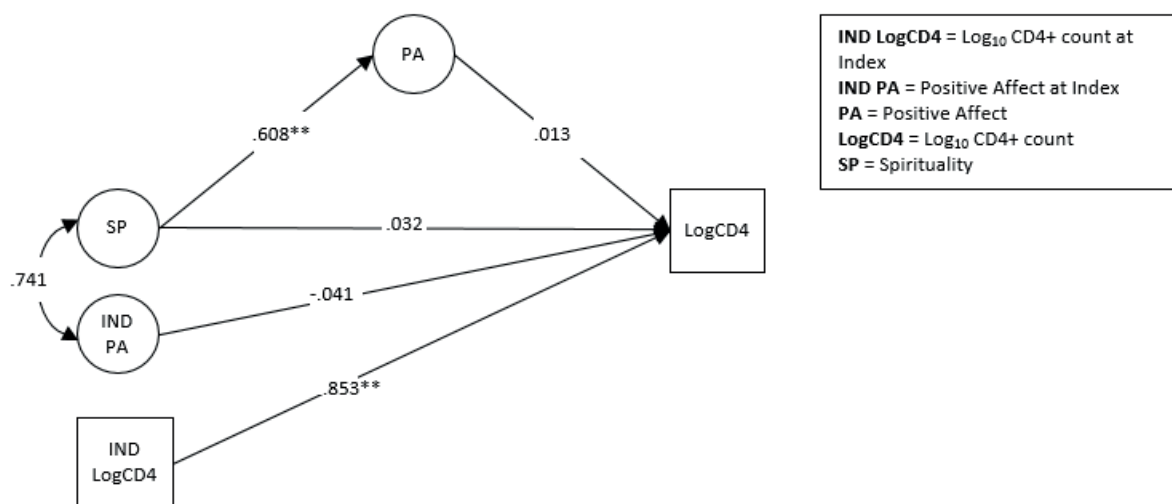
Figure A-5. Pathways with STDYX standardized regression coefficients for model partially mediated by positive affect, controlling for positive affect at index and CD4+ count at index. X^2 = 2463.69, RMSEA = 0.085, CFI = 0.793, SRMR = 0.082. **p <0.01.

Appendix B: Supplemental Analyses for Study 1 – Examining Health Care Empowerment

In Study 1, we examined whether the relationship between spirituality and viral load was mediated by positive affect or ART adherence. As spirituality was associated with better adherence and higher positive affect, we wanted to know whether spirituality in a cross-sectional manner (at index visit) independently predicted health care empowerment (HCE) in this sample. However, given that this was a different question and we had to use differing methods from those employed in Study 1, we felt that this set of analyses was best suited to an appendix.

We examined the cross-sectional relationship between spirituality and HCE using the FACIT-Sp-12[21] and the Health Care Empowerment Inventory,[170] which is comprised of two subscales: The informed, committed, collaborative and engaged subscale (HCE ICCE), which is comprised of four questions (e.g., I prefer to get as much information as possible about treatment options; I take my commitment to my treatment seriously), measured on a 1 (strongly disagree) – 5 (strongly agree) scale. The second subscale, tolerance of uncertainty (HCE TU), is likewise comprised of four questions (e.g., I accept that the future of my health condition is unknown even if I do everything I can; I have learned to live with the uncertainty of my health condition), and is measured on the same 1 -5 scale. Scores are summed for each subscale.

We first examined descriptive statistics (See Table B-1) and bivariate correlations (See Table B-2). Bivariate correlations indicated that spirituality was positively correlated with HCE. We then examined whether spirituality independently predicted health care empowerment for both HCE ICCE and HCE TU using multivariate hierarchical regressions.

When examining whether spirituality independently predicted HCE ICCE, the F values for all regressions were statistically significant. See Table B-3. In the uncontrolled association, spirituality ($\beta = 0.21$, $p < 0.01$) independently predicted HCE ICCE. In regressions controlling

for positive affect, spirituality (β =0.17, p < 0.01) continued to independently predict HCE ICCE, whereas positive affect (β =0.06, p = 0.10) trended toward predicting HCE ICCE. After adding age, race (dummy coded as white [0] vs. non-white [1]), and education into the model, spirituality (β = 0.16, p < 0.01) continued to predicted HCE ICCE, and positive affect (β =0.07, p < 0.05) met statistical significance as a predictor. See Table B-4.

When examining whether spirituality independently predicted HCE TU, the F values for all regressions were statistically significant. See Table B-3. In the uncontrolled association, spirituality (β = 0.15, p < 0.01) independently predicted HCE TU. In regressions controlling for positive affect, spirituality (β = 0.18, p < 0.01) continued to independently predict HCE TU, whereas positive affect did not predict HCE TU. After adding age, race, and education into the model, spirituality (β = 0.18, p < 0.01) independently predicted HCE TU, whereas positive affect did not predict HCE TU. See Table B-4.

Results of the current analyses indicate that spirituality independently predicts health care empowerment, a concept that has been negatively correlated with Log_{10} viral load and positive correlated with CD4+ count in samples of PLWH.[170] Results of these analyses support the idea that spirituality is salubrious for people living with HIV. Results also indicate that positive affect may be a useful predictor of HCE ICCE, and future research should work to make this relationship more clear by examining whether positive affect predicts certain aspects of the HCE ICCE subscale. Future research can also build upon findings in the current spirituality analyses, as while this research shows that spirituality predicts HCE in a cross-sectional manner, it is as yet unclear whether spirituality predicts HCE longitudinally. Future research should also examine whether HCE mediates a relationship between spirituality and biomarkers that HCE has been shown to predict, such as viral load and CD4+ count.

Table B-1

Descriptive Statistics

Measure	N	Range	M (SD)
SP	1387	2-49	38.67 (9.13)
PA	1520	4-16	13.38 (3.11)
HCE ICCE	1380	4-20	18.05 (2.13)
HCE TU	1380	4-20	16.03 (3.20)

Note. HCE ICCE = Health Care Empowerment – Informed, committed, collaborated, engaged; HCE TU = Health Care Empowerment – Tolerant of uncertainty; PA = positive affect; SP = spirituality

Table B-2

Cross-Sectional Bivariate Correlations between Variables of Interest

	1	2	3	4	5	6
1. HCE ICCE	1					
2. HCE TU	0.36**	1				
3. SP	0.21**	0.14**	1			
4. PA	0.17**	0.06*	0.64**	1		
5. CD4+	0.12**	0.02	0.09**	0.07**	1	
6. Log_{10} VL	-0.15**	-0.03	-0.10**	-0.11**	-0.49**	1

Note. HCE ICCE = Health Care Empowerment – Informed, committed, collaborated, engaged; HCE TU = Health Care Empowerment – Tolerant of uncertainty; HCE sum = HCE sum score; CD4+ = CD4+ count; Log10 VL = log_{10} viral load; PA = positive affect; SP = spirituality
Note. **p < 0.01; * *p* < 0.05.

Table B-3

Model Change for Multivariate Hierarchical Regressions with the FACIT-Sp-12 or IWSR and Positive Affect

Outcome	Predictors of Interest	Model	Predictors	R^2	Adjusted R^2	F Value	F Change
HCE ICCE	FACIT-Sp-12	Model 1	FACIT-Sp-12	0.04	0.04	59.95**	59.95**
		Model 2	FACIT-Sp-12, PA	0.05	0.04	31.39**	2.75
		Model 3	FACIT-Sp-12, PA, Age, Race, Income	0.05	0.05	15.16**	4.20**
HCE TU	FACIT-Sp-12	Model 1	FACIT-Sp-12	0.02	0.02	32.53**	32.53**
		Model 2	FACIT-Sp-12, PA	0.03	0.02	17.09**	1.63
		Model 3	FACIT-Sp-12, PA, Age, Race, Income	0.03	0.03	9.50**	4.35**

Note. HCE ICCE = Health Care Empowerment – Informed, committed, collaborated, engaged; HCE TU = Health Care Empowerment – Tolerant of uncertainty; PA = positive affect
Note. ** $p < 0.01$

Table B-4

Multivariate Hierarchical Regressions with the FACIT-Sp-12

Outcome	Predictors of Interest	Model	Predictors in Model	*B*	*SE B*	*β*
HCE ICCE	FACIT-Sp-12	Model 1	FACIT-Sp-12	0.05	0.01	0.21**
		Model 2	FACIT-Sp-12	0.04	0.01	0.17**
			PA	0.04	0.02	0.06
		Model 3	FACIT-Sp-12	0.04	0.01	0.16**
			PA	0.04	0.02	0.07*
			Age	0.02	0.01	0.08**
			Race	-0.17	0.16	-0.03
			Income	-0.03	0.03	-0.03
HCE TU	FACIT-Sp-12	Model 1	FACIT-Sp-12	0.05	0.01	0.15**
		Model 2	FACIT-Sp-12	0.06	0.01	0.18**
			PA	-0.05	0.04	-0.05
		Model 3	FACIT-Sp-12	0.06	0.01	0.18**
			PA	-0.04	0.04	-0.04
			Age	0.03	0.01	0.08**
			Race	-0.38	0.25	0.04
			Income	-0.07	0.05	-0.04

Note. HCE ICCE = Health Care Empowerment – Informed, committed, collaborated, engaged; HCE TU = Health Care Empowerment – Tolerant of uncertainty; PA = positive affect
Note. ** $p < 0.01$; * $p < 0.05$.

Appendix C – Supplemental Analyses for Study 1: Examining Health Care Utilization

In Study 1, we examined whether the relationship between spirituality and viral load was mediated by positive affect or ART adherence. As spirituality predicted adherence to ART six months later in this sample, we explanatorily examined whether spirituality predicted health care utilization (HCU) six months later. We examined this using the FACIT-Sp-12[21] and a single item question administered by WIHS, which asked "In the last six months, how many times did you go for regular HIV care?" In addition we explored whether positive affect predicted HCU six months later.

We first examined descriptive statistics (See Table C-1) and bivariate correlations (See Table C-2). Bivariate correlations indicated that neither spirituality nor positive affect were correlated with HCU six months later. We then examined whether spirituality or positive affect independently predicted HCU.

As expected, no F values for any regressions were statistically significant. See Table C-3. In uncontrolled associations, neither spirituality (β = -0.01, p = 0.16) nor positive affect (β =-0.02, p = 0.25) predicted HCU. Similarly, neither spirituality (β = -0.01, p =0.32) nor positive affect (β = 0.00, p = 0.87 predicted HCU when in the same regression model. See Table C-4 As descriptive statistics indicated a wide range of HCU (0-32 visits over the past 6 months), we also conducted analyses with only WLWH who had gone for regular HIV care 6 or fewer times over the past 6 months. There were no statistically significant differences between results for analyses conducted with the full sample and analyses conducted with the subset of women who had only gone for HIV care 6 or fewer times.

Results of the current analyses indicate that neither spirituality nor positive affect predict HCU six months later in WLWH. Future research should examine whether spirituality or

positive affect predict HCU in other groups of PLWH (e.g., men, adolescents), as current analyses were only conducted with WLWH. However, results indicate that clinicians should not rely on spirituality or positive affect when trying to change HCU in WLWH.

Table C-1

Descriptive Statistics

Measure	N	Range	M (SD)
SP	1391	2-50	39.25 (8.91)
PA	1446	4-16	13.53 (3.06)
HCU	1424	0-32	1.76 (1.71)

Note. HCU = Health care utilization; PA = positive affect; SP = spirituality

Table C-2

Cross-Sectional Bivariate Correlations between Variables of Interest

	1	2	3
1. SP	1		
2. PA	0.67[**]	1	
3. HCU	-0.04	-0.03	1

Note. HCU = Health care utilization; PA = positive affect; SP = spirituality
Note. ** $p < 0.01$

Table C-3

Model Change for Multivariate Hierarchical Regressions with the FACIT-Sp-12 and Positive Affect

Outcome	Predictors	R^2	Adjusted R^2	F Value	F Change
HCU	SP	0.002	0.001	2.01	2.01
	PA	0.001	0.000	1.34	1.34
	SP & PA	0.002	0.000	1.06	1.06

Note. HCU = Health care utilization; PA = positive affect; SP = spirituality

Table C-4

Multivariate Hierarchical Regressions with the FACIT-Sp-12 and Positive Affect

Outcome	Predictors of Interest	Model	Predictors in Model	*B*	*SE B*	*β*
HCU	SP	Model 1	SP	-0.01	0.01	-0.04
	PA	Model 2	PA	-0.02	0.01	-0.03
	SP & PA	Model 3	SP	-0.01	0.01	-0.04
			PA	0.00	0.02	-0.01

Note. HCU = Health care utilization PA = positive affect; SP = spirituality