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Stress Management, Depression and Immune Status in Lower Income Racial/Ethnic Minority Women Co-infected with HIV and HPV

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Abstract

The stress of co-infection with HIV and Human Papillomavirus (HPV), in race/ethnic minority women, may increase depression and immune decrements. Compromised immunity in HIV+ HPV + women may increase the odds of cervical dysplasia. Thus we tested the efficacy of a 10-wk cognitive behavioral stress management (CBSM) group intervention and hypothesized that CBSM would decrease depression and improve immune status (CD4+ T-cells, natural killer [NK] cells). HIV+HPV+ women (n=71) completed the Beck Depression Inventory (BDI) and provided blood samples, were randomized to CBSM or a control condition, and were re-assessed post-intervention. Women in CBSM revealed less depression, greater NK cells, and marginally greater CD4+ T-cells post-intervention vs. controls. Stress management may improve mood and immunity in HIV+HPV+ lower income minority women.

Introduction

The incidence of Human Immunodeficiency Virus (HIV) infection and Acquired Immunodeficiency Syndrome (AIDS) in the United States is increasing more rapidly among women, specifically in women of color, than in any other defined population at risk for HIV infection (CDC, 2007). Recent studies have found that women infected with HIV have increased prevalence, incidence, and persistence rates of human papillomavirus (HPV) infection, cervical neoplasia and invasive cervical cancer (Hankins et al., 1999; Massad et al., 1999). Approximately 40% of women with HIV may develop a neoplastic lesion (Goedert, 1998), which can then lead to cervical cancer (Tachezy, 2003). Even with standard treatment, recurrence of cervical intraepithelial neoplasia (CIN) persists in women who have HIV, and studies show that the severity of cervical lesions are inversely correlated with immune function (Boccalon, Tirelli, Sopracoredevoli, & Vaccher, 1996). Moreover, research examining cellular immune activity in progression of CIN shows that regressors (individuals with baseline gynecological abnormalities that regressed to normal results by follow-up) show an increase of CD4+ T-cell counts at follow-up (Moore et al., 2002). Other studies have found that HPV recurrence is associated with decreased Natural Killer (NK) cell count (Stentella et al., 1998), and that patients with spontaneous regression of cervical dysplasia show higher levels of NK cell activity (Garzetti et al., 1995).

Individual differences in psychological variables such as depression have been related to health status in HIV-infected persons (Leserman, 2008). Studies examining the psychosocial impact of an HIV+HPV+ diagnosis have found increased stress reports and depression rates when compared with women with neither diagnosis (McCaffery, Waller, Nazroo, & Wardle, 2006; Clarke, Ebel, Catotti, & Stewart, 1996; Kabbash, El-Gueneidy, Sharaf, Hassan, & Al-

Nawawy, 2008; Siegel & Schrimshaw, 2005). One meta-analysis reported that depression rates in persons with HIV are twice those of HIV seronegative individuals (Ciesla & Roberts, 2001). We also know that people with HIV who report lower life stress and fewer depressive symptoms show less declines in CD4+ T-cell percentages at 6 month follow-up (Patterson et al., 1995). Depression has been associated with enumerative immune measures (e.g. lower CD4+ T-cells) that hastened disease progression in HIV+ persons (Leserman, 2008). Furthermore, studies have shown a relationship between both depression and severe stress with lower NK cells (Evans et al., 1995; Alciati, Gallo, Monforte, Brambilla, & Mellado, 2007).

Given the evidence, it appears that HIV+HPV+ women, especially those from race/ethnic minority groups, are particularly vulnerable to experiencing a variety of psychological stressors that may exacerbate depressive symptoms, which can then influence immune system functioning and susceptibility to disease progression. As mentioned previously, HIV +HPV+ women experience higher rates of depressive symptoms than women with neither diagnosis. These psychosocial factors have been associated with immunological changes, which in turn have been shown to play a role in HIV disease progression and HPV-associated neoplasias (Massad et al., 1999; Palefsky, 2003; Harris et al., 2005; Bonneau, 1994; Ho et al., 1995; Grinsztejn et al., 2008). It would be plausible to suggest then that this population, who is dealing with considerable amounts of challenges, would benefit from behavioral interventions designed to lower stress, such as those that teach cognitive behavioral techniques that help individuals cope and manage their distress.

Currently, there is growing evidence that stress management interventions are effective and beneficial to distressed medical populations. The literature on HIV has shown that stress management interventions can buffer declines of CD4+ T-cells, decrease depressed mood, and elevate quality of life (Creswell, Myers, Cole, &Irwin, 2009; Chan et al., 2004; Crepaz et al., 2008). One intervention in particular, group-based Cognitive Behavioral Stress Management (CBSM) intervention has received much attention due to its effectiveness in improving adjustment and physical health indicators in populations that are HIV+ (Carrico & Antoni, 2008). CBSM has been shown to improve depression and anxiety in a sample of homosexual men awaiting HIV status notification (Antoni et al., 1991), and in minority women living with HIV (Laperriere et al., 2005; Lechner et al., 2003). In one study of homosexual men awaiting HIV status notification, those receiving CBSM showed increases in helper CD4+ T-cells, NK cell counts, and NKCC compared to controls pre to post-intervention (Antoni et al., 1991). Other studies have replicated these CBSM findings on depressed mood, anxiety, and distress in gay men with symptomatic HIV (Antoni et al., 1991, Carrico, Antoni, Weaver, Lechner, & Schneiderman, 2005). Finally, prior studies of women with both HIV and HPV have shown that CBSM appears to lower the odds of persistent cervical neoplasia (Antoni et al., 2008).

The present study conducted secondary analysis on data collected in the latter trial (Antoni et al., 2008). Specifically, we examined whether CBSM influences aspects of depression and immune status in lower income race/ethnic minority HIV+HPV+ women. We hypothesized that women receiving a CBSM intervention would show a decrease in depression symptoms and improvements in immune status (i.e., increased CD4+ T-cells and NK cells) from baseline to post-intervention. We also hypothesized that CBSM effects on immune variables would be largest in women showing the greatest decreases in depression. Finally we examined which of the targets of this intervention (e.g., perceived relaxation skills, improved interpersonal skills etc.) are associated with improvements in depression.

Methods

Participants and Procedures

Participants were recruited from the Special Immunology Clinic at the Department of Obstetrics and Gynecology at the University of Miami/Jackson Memorial Hospitals, where patients received routine gynecological, prenatal, postpartum, family planning, and primary care. Women eligible to participate in the study were co-infected with HIV and HPV, between the ages of 18 to 60, had a history of Papanicolaou smears indicating low-grade squamous intraepithelial lesions (LGSIL) or at least two cervical biopsies indicating atypical cells of undetermined significance (ASCUS) in the two years prior to baseline entry, had a CD4+CD3+ cell count above 200 cells/mm^3, and were fluent in English. Exclusion criteria included two or more negative Papanicolaou smears in the two years prior to baseline entry; a history of high-grade SIL diagnosis, or invasive cervical cancer; being on immunotherapy; pregnant or postpartum less than six weeks. Women were also required to have a 6^{th} grade reading and writing level, and not be experiencing any major psychiatric illnesses, substance abuse or suicidality.

Of the 142 women screened for the study, 53 did not meet study criteria, 17 were unwilling to participate, and 2 were missing data on variables of interest. The final sample consisted of 71 participants; 46 were randomized to the CBSM condition and 25 to the control group. A Consort Flow Diagram is shown on Figure 1. Data from baseline and post-intervention (3 month after baseline) were utilized for this study. Characteristics by group are shown in Table 1. Additionally, psychosocial and immunological outcomes by group at baseline and post-intervention are shown in Table 2. At baseline, participants completed an informed consent, medical history interview, underwent a colposcopy, provided a cervical swab for HPV testing, and provided morning peripheral venous blood samples (between 8:00am – 12:00pm). Gynecological history and chart review were used to establish eligibility criteria of a history of papanicolaou smears indicating LGSIL or at least two cervical biopsies indicating ASCUS in the two years prior to study entry. An in-person psychosocial assessment interview was also conducted at baseline and included a well-validated measure of depression (e.g. Beck Depression Inventory; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). After the psychosocial assessment interview, participants were randomized to CBSM or to the control condition. A 2:1 ratio procedure was implemented as it allowed randomization of six participants to the CBSM condition per cohort, which has been found to be an appropriate size to conduct a CBSM group (Antoni, Ironson, & Schneiderman, 2007). Furthermore, a 2:1 procedure enhanced recruitment among women potentially reluctant to enroll in the study. This provided a greater chance of being assigned to the experimental condition and allowed more individuals to receive the intervention.

CBSM intervention—The CBSM condition comprised ten group-based 2.5 hour weekly sessions consisting of relaxation training (e.g. progressive muscle relaxation, diaphragmatic breathing, autogenics and mindfulness meditation), and a didactic cognitive behavioral component (cognitive restructuring, coping effectiveness training, assertion training, anger management and social support building techniques). The intervention employed a similar format as previous CBSM studies conducted with HIV+ women and men (Pereira, 2002), but included modifications designed to make the intervention more applicable for low-income minority women who were HIV+HPV+ (Antoni et al., 2008). These changes included education on cervical health, overcoming barriers for gynecological treatment, and utilizing intrapersonal, spiritual, and social resources to negotiate safer sex. Sessions were conducted according to a training manual by a post-doctoral associate and advanced clinical psychology graduate students.

Psycho-education control—Women who were randomized to the control condition were invited to attend a one-day seminar where they received a summary of general health information and stress management in a group setting. The control condition differed from the intervention in having less contact hours, lack of structured group interactions, and absence of homework or assigned home based practice. It can be conceptualized as a minimal contact educational control focusing on assorted self-help topics relevant to stress, coping, and health in HIV.

Measures

Beck depression inventory (BDI)—(Beck, Ward, Mendelson, & Erbaugh, 1961). The BDI is a widely used 21 item multiple choice self report measure designed to assess symptoms of depression. The measure is designed for individuals 13 or older, and is composed of items asking about hopelessness, weight loss, fatigue, guilt etc. in order to assess severity of depression. The BDI produces a total score and cognitive-affective and somatic subscale scores. The BDI has a split half Spearman-Brown reliability of .93 for psychiatric patients (Beck, 1970), and a mean alpha coefficient of .81 for non-psychiatric patients (Beck, Steer, & Garbin, 1988). The BDI correlates highly with alternative depression measures such as the Hamilton Rating Scale for Depression (mean= .73 in psychiatric samples) and the Zung Self Reported Depression Scale (mean= .76 in psychiatric samples) and discriminates well between several different groups of both psychiatric and non-psychiatric populations (Beck, Steer, & Garbin, 1988). The BDI has been used frequently with individuals infected with HIV and has been shown to improve over the course of the 10 week CBSM intervention in men with HIV (Lutgendorf et al., 1997; Lutgendorf et al., 1998). The mean BDI for the participants was 9.34 *(SD= 12.80; range = 0 – 44, α = .92)*.

Immunologic Measures

Immune measures utilized in this study included HIV viral load, T-helper cells (CD4+), and NK cells (CD56+). Blood draws were performed by a trained phlebotomist at the Women's Health Initiative Program (WHI) at the UM/JMH campus and were taken to the E.M. Papper Clinical Immunology Laboratory within two hours of draw. Enumeration of lymphocyte subpopulations was determined by flow cytometry and 4-color direct immunofluorescence as outlined by Ironson et al. (1997). HIV viral load was determined through an ultrasensitive in vitro reverse transcriptase polymerase chain reaction assay (AMPLICOR, Roche Laboratories, US #83088) with a lower limit of 50 copies/ml.

Statistical Analyses

Hierarchical multiple regression analyses tested for group differences (CBSM vs. control) in post-intervention depression while controlling for baseline levels in addition to putative confounding variables. To determine potential confounders, we ran independent t-tests and chi square tests comparing the CBSM vs. control group on a set of sociodemographic and health variables at baseline. Candidate covariates included HIV medications, such as highly active antiretroviral therapy, sleep quality, adherence to medications, illicit drug use, number of cigarettes smoked, caffeine, alcohol, antihistamines, and nicotine use, as they have been shown to contribute to mood, hormonal and immunologic changes (Kuhn, 1989; Sellmeyer & Grunfeld, 1996). None of these measures differed by group assignment. However, we decided to control for sleep quality via the Pittsburgh Sleep Quality Index (PSQI; Buysse, Reynolds, Monk, Berman, & Kupfer, 1995) as it was correlated with depression symptoms at study entry.

We also examined associations between the immune measures, CD4+ cell and NK cell counts, and multiple demographic, health behaviors, medications, and medical co-

morbidities that could affect the immune system (see Table 3). As can be seen, there were very few associations between these patient characteristics and immune measures. Less education, greater time since diagnosis, and being on a Nucleoside Reverse Transcriptase Inhibitor (NRTI) medication regimen were associated with lower CD4+ cell counts at study entry, while greater age related to lower NK cell counts. However, all of these factors were equally balanced between CBSM and controls. There were no associations between immune measures and health behaviors (e.g., unsafe sex, tobacco, alcohol, or substance use), medical co-morbidities, or gynecological health history. Therefore we did not control for any of these variables in our analyses.

Fifty-three percent of participants reported taking highly active antiretroviral therapy (HAART) medications at study entry, and 51% of individuals on HAART with complete self-reported adherence data reported 100% adherence to their regimen in the four days prior to study entry. For this sample, baseline self-reported adherence was not significantly correlated with depression (r=−0.16, p=.92), CD4 cells (r=0.10, p=.53), NK cells (r=0.17, p=.30), or HIV viral load (r=−0.30, p=.19) at post-intervention. There was a 50% mean attendance rate for women in the one day seminar condition and a 45% attendance rate for women in the CBSM condition. Attendance rate was not significantly correlated with outcomes for either group (all p's= *ns*).

To examine whether CBSM-associated changes in immune system indicators paralleled the magnitude of reductions in depressive symptoms the bootstrap method was used to test mediation, to estimate direct and indirect effects, and estimate confidence intervals. Bootstrapping is the preferred method for testing mediation and is recommended for small sample sizes as it provides a more precise estimate of indirect effects (Preacher & Hayes, 2008). The SPSS default bootstrap command was utilized which requests 1,000 bootstrap re-samples.

Missing follow-up data was imputed in the present study by utilizing a linear interpolation method (Little & Rubin, 1987). This method is an improvement over mean substitution in that the value substituted is predicted from variables within the same scale of the same person (Norazian, Ahmad Shukri, Ramli, & Mohd Mustafa, 2007). Linear interpolation links the observed values before and after the missing value, such that the missing value at x=x is imputed by the mean value at x=x−1 and x=x+1. The amount of missing values in the present data ranged from 1–18 values for the BDI, and 4–18 values for immune variables. The majority of missing data for outcome measures was found at post-intervention. Furthermore, psychosocial and immunological data was indicated to be missing completely at random as shown by Little's MCAR test (X^2= 9.68, DF= 11, p= .560).

Results

Mood effects

Assignment to the CBSM group significantly predicted decreases in BDI somatic subscale scores at post-intervention (ΔR^2= .05, p < .05) but did not affect BDI total or BDI cognitive-affective subscale scores (p's > .05). To determine whether CBSM effects on depression were independent of changes in sleep quality we re-ran regression analyses controlling for sleep quality as a covariate. Significant effects of decreases in the BDI somatic subscale remained even after including sleep quality as a control variable (ΔR^2= .07, p < .03). Because of the significant CBSM effect on depression, exploratory analyses looking at anxiety and confidence in using relaxation as outcomes were also conducted to investigate if women showed parallel changes in these psychological variables during the intervention. Assignment to CBSM did not predict differences in anxiety at post-intervention (p = *ns*). However, assignment to CBSM significantly predicted greater confidence in using

relaxation techniques ($\Delta R^2 = .08$, $p < .04$) as measured by the Measure of Current Status scale (MOCS; Carver, 2006). Increases in relaxation confidence for women in CBSM were, in turn, significantly correlated with reductions in BDI somatic scores ($r = -.37$, $p = .007$).

Immune effects

To examine whether assignment to CBSM predicted improved immune status at post-intervention and whether CBSM-associated changes in immune system indicators paralleled the magnitude of reductions in somatic depressive symptoms, bootstrapping analyses were performed on CD4+ T-cell counts and somatic depression scores at post-intervention. Bootstrapping results revealed that assignment to CBSM was marginally significantly associated with greater CD4+ T-cells ($b = 106.27$, $SE = 56.89$, $t(66) = 1.87$, $p = .06$) as shown in Table 4. Assignment to CBSM was also significantly associated with lower BDI somatic subscale scores ($b = -1.29$, $SE = .67$, $t(66) = -1.93$, $p < .05$). The BDI somatic subscale ($b = -21.39$, $SE = 10.12$, $t(66) = -2.11$, $p = .04$), in turn, was inversely associated with post-intervention CD4+T-cell counts. The direct effect of assignment to CBSM on CD4+ T-cells with the BDI somatic subscale in the equation was reduced to $b = 78.69$, $SE = 56.98$ ($t(66) = 1.38$, *ns*) suggesting that reductions in BDI somatic depression accounted, in part, for the effects of the intervention on CD4+ T-cells. Furthermore, the indirect effect of assignment to CBSM on CD4+ T-cells through the BDI somatic subscale was significant (bootstrap estimated indirect effect =25.92, CI= 3.77, 74.35, $p < .001$). The total amount of variance accounted by for the complete model was 34% (Adj. $R^2 = .34$, $p < .001$). These results support the hypothesis that a CBSM intervention may increase CD4+ T-cell count in HIV+HIV+ women, an effect that is paralleled by reductions in BDI somatic depression scores. Given the association between sleep quality and depression, bootstrapping analyses controlling for sleep quality were also tested. Findings remained significant with inclusion of sleep quality as a covariate, supporting a depression mediation model.

Bootstrapping results also revealed that assignment to CBSM was significantly associated with greater NK cells at post-intervention ($b = 24.44$, $SE = 11.56$, $t(66) = 2.12$, $p = .04$). However, the BDI somatic subscale was not significantly associated with higher NK cell counts ($b = -.91$, $SE = 1.95$, $t(66) = 1.31$, $p = .64$), suggesting that reductions in depressive symptoms did not explain the effects of CBSM on NK cells. (See table 4). Lastly, results revealed that group assignment did not significantly predict post-intervention variance in viral load. See figure 2 for CBSM and control condition effects on BDI somatic, NK cells, and CD4+ cells.

Discussion

The present study was based upon secondary analyses of the effects of a group-based CBSM intervention designed to help lower income racial/ethnic minority women living with HIV to cope with the stress of their illness. Because of the added vulnerability to HPV infection that many lower-income race/ethnic minority women with HIV suffer (Andrasik, Rose, Pereira, & Antoni, 2008), we recruited a sample of low-income minority women co-infected with HIV and HPV and tested the ability of a CBSM intervention that had been tailored for this group. Primary outcomes for this intervention can be found in Antoni et al., 2008. Results of the present secondary analyses revealed that women assigned to CBSM reported lower post-intervention somatic depression symptoms and increased perceived relaxation skills, as well as showing significantly increased CD56+ NK cells and marginally increased CD4+ T-cells compared to controls. These findings are important for the present population given the established relationship between CD4+ T-cells and HIV progression (Bonneau, 1994; Ho et al., 1995) and the role of CD56+ NK and CD4+ T-cells in helping the immune system successfully control the HPV virus (Garcia-Iglesias et al. 2009, Moore et al., 2002; Harris et al., 2005, Woo et al., 2008). It was also revealed that perceived relaxation skills correlated

significantly with BDI somatic scores, which may point to a treatment component that is effective in reducing depression. These results are in accordance with previous studies showing that CBSM attenuates depressive symptoms in heterosexual and homosexual men and minority women infected with HIV (Antoni et al., 1991; Laperriere et al., 2005; Lechner et al., 2003; Lutgendorf et al., 1997; Carrico, Antoni, Weaver, Lechner & Schneiderman, 2005; Carrico & Antoni, 2008). In this particular study CBSM effects were found for somatic depressive symptoms, which may be due to differences in reports of depression symptoms found in ethnically and culturally diverse populations. Indeed, some studies have demonstrated differences in expressions of distress, with immigrant or minority populations expressing physical symptoms or somatization more often than their more westernized counterparts (Kirmayer, 2001; Baarnhielm & Ekblad, 2000).

Results also supported a model relating somatic depression changes during CBSM with immunological changes. Specifically, bootstrapping analyses showed that the effects of CBSM on CD4+ cells over time were explained, in part, by women's greater decreases in somatic depression symptoms. Findings provide further support to previous CBSM studies demonstrating a relationship between reductions in depressive symptoms and improvement in immune indices (Antoni et al., 1991; Antoni et al., 2005). This appears to be a consistent finding even in a relatively small and diverse sample as presented here. Since our outcome measurements of psychological and immunological variables occurred at post-intervention concurrently, there is a possibility that the relationship between depression and immune changes may be bi-directional. However, there is longitudinal research supporting a sequential relationship of depressive symptoms and immune changes in persons with HIV/AIDS (Leserman et al., 1997; Antoni et al., 2006; Laperriere et al., 2005). Interestingly, while CBSM was associated with increases in NK cell counts these changes were not accounted for by changes in somatic depression suggesting that other psychological changes potentially occurring during CBSM (e.g., social support, coping) may be more closely aligned with NK cell changes.

Overall, results suggest that CBSM is beneficial in reducing somatic depression and preserving immunological status in a vulnerable minority population dealing with HIV and HPV co-infection who are at risk for negative health outcomes such as cervical cancer. Given the dearth of research in this area, there is a need for future research investigating similar biobehavioral relationships and their influence on disease outcomes in HIV+HPV+ women (Andrasik, Rose, Pereira, & Antoni, 2008).

As with all studies utilizing small samples with missing data, interpretation of results should be made with caution due to limitations in power and biases introduced by missing data estimation techniques. Specifically, significant indirect effects may not be as stable due to the small sample size. The control group used in the present study did not match equivalence of patient contact between groups, creating a marked difference in attention time between conditions. Also, information on whether women were on hormonal treatment or if they were post-menopausal was unavailable. The generalizability of results is limited to low-income ethnically diverse women. Furthermore, due to the lack of data at longer-term follow-up it was not feasible to test longer-term effects to determine if immune improvements were maintained. Future work with a larger sample and longer follow-up period is indicated.

Future studies should pay particular attention to alternative psychological and ecological processes that may be quite relevant to low-income minority women co-infected with HIV and HPV. Inclusion of spiritually and culturally pertinent factors may provide researchers with a better understanding of the experiences of minority women dealing with deteriorating health and a lack of basic resources. For instance, the importance of spirituality and social

support in health and healing in minority cultural groups has been well established (Brome, Owens, Allen, & Vevaina, 2000; Potts, 1996; Hodge et al., 2000), with particular medical populations, such as those living with HIV and cancer, also gaining benefits (Galvan, David, Banks, & Bing, 2008; Crawford, Allison, Zamboni, & Soto, 2002; Lagos et al., 2008; Avants & Margolin, 2004; Yanez et al., 2009). Other relevant work has shown the importance of maintaining a sense of ethnic identity in managing stress levels among lower income minority women with HIV (Lopez, Antoni, Fekete, & Penedo, 2012).

In conclusion, the present work identifies CBSM effects on depressive symptoms and immune status in a sample of lower income racial/ethnic minority women living with HIV and HPV infection. Our results suggested that CBSM was beneficial in ameliorating somatic symptoms of depression and preserving immune status evidenced by CD4+ and NK cells. A biobehavioral model was supported where the effects of CBSM on psychological changes may have contributed to immunological status found at post-intervention. However, this model must be viewed as tentative until a larger sample can be collected that can fully elucidate the trajectories of disease over longer time periods.

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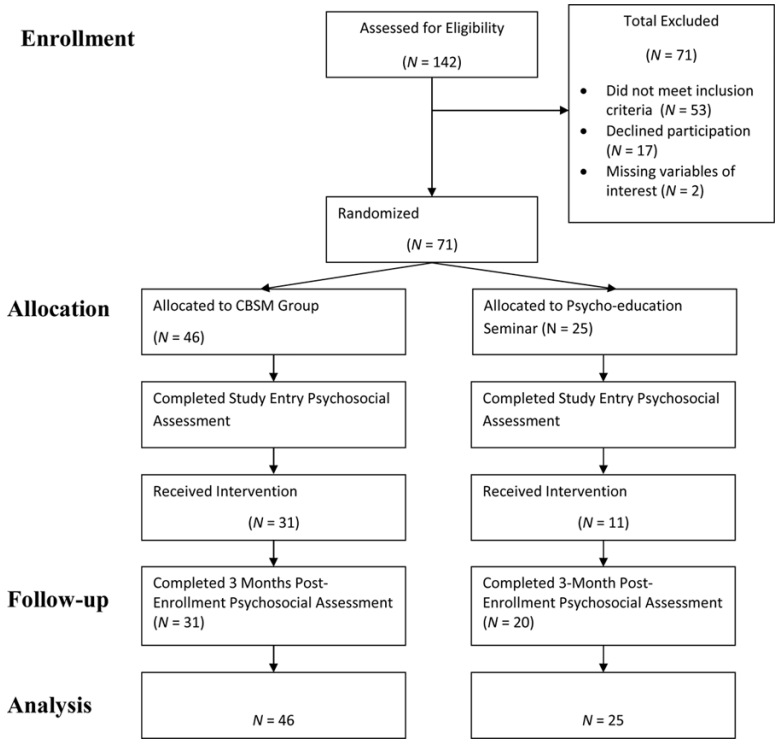
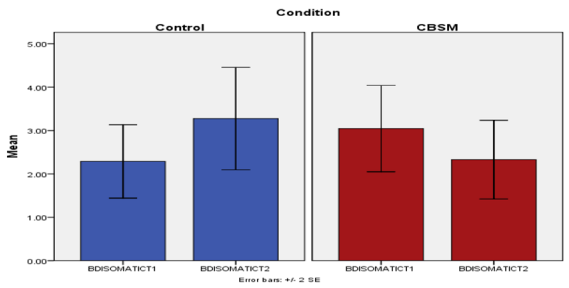


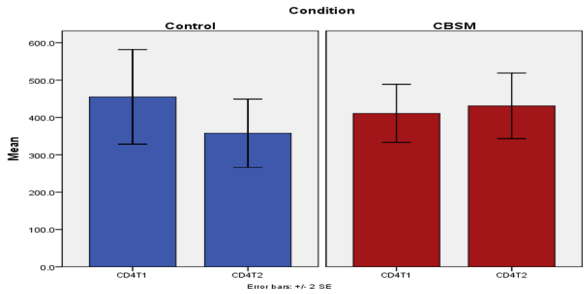
Figure 1.

Participant flow diagram for the present randomized clinical trial.
*Only data from pre-post intervention was utilized for this study.

A.



B.



C.

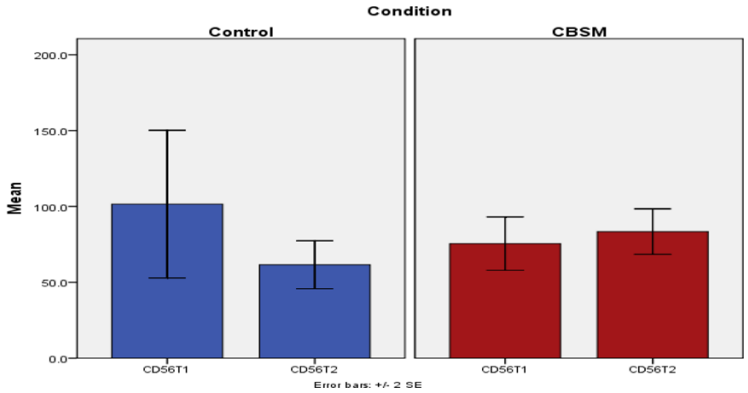


Figure 2.

CBSM and control condition effects on BDI somatic (A), CD4+ cells/mm^3 (B), and Natural killer (NK) cells/mm^3 (C), from baseline (T1) to post-intervention (T2).

Table 1

Characteristics of Sample.

Variables	CBSM	Control
Demographics		
Mean Age	31.89*(SD=8.45)*	30.19*(SD=8.41)*
Ethnicity	62.2% Black 17.8% Black Other 11.2% Latina 4.4% Caribbean 2.2% Caucasian 2.2% Asian	73.1% Black 15.4% Latina 7.1% Caribbean 2.2% Caucasian 2.2% Asian
Marital Status	55.6% Single 22.1% Married 8.9% Divorced 6.7% Separated 6.7% Widowed	50.1% Single 19.2% Married 15.4% Separated 11.5% Divorced 3.8% Widowed
Number of Children	1.73*(SD=1.33)*	1.88*(SD=1.42)*
Mean years of Education	11.69*(SD=1.74)*	11.32*(SD=1.35)*
Job Status	60% Full Time 26.7% Part Time 6.7% Disability 6.7% Student	75% Full Time 12.5% Student 6.3% Part Time 6.3% Disability
Average Yearly Income	$11, 957.82*(SD=8,642.50)*	$11,070.00*(SD-8,290.95)*
HIV History and Treatment		
Mean Months Since Diagnosis	72.69*(49.30)*	84.04*(47.15)*
HIV Medications: NNRTI	Yes 10.5% No 89.5%	Yes 22.7% No 77.3%
NRTI	Yes 76% No 24%	Yes 70.6% No 29.4%
MCC	Yes 18% No 82%	Yes 13.0% No 87.0%
Protease Inhibitor	Yes 23.7% No 76.3%	Yes 26.1% No 73.9%
OB/GYN		
Cervical Dysplasia at study entry	Yes 79.5% No 20.5%	Yes 88.5% No 11.5%
History of Syphilis	Yes 22.7% No 77.3% Unknown 2.3%	Yes 26.9% No 65.4% Unknown 7.7%
History of Chlamydia	Yes 34.1% No 65.9%	Yes 23.1% No 69.2% Unknown 7.7%
History of Genital Herpes	Yes 27.3% No 70.5% Unknown 2.3%	Yes 30.8% No 61.5% Unknown 7.7%
Leukoplakia in Cervix	Yes 2.3% No 97.7%	Yes 7.7% No 92.3%

SD= Standard Deviation; NNRTI= Non-nucleoside reverse transcriptase inhibitor; NRTI= Nucleoside reverse transcriptase inhibitor; MCC= Multi-Class combination;

Table 2

Psychosocial and immunological outcome variables at baseline (T1) and post-intervention (T2).

	CBSM		CONTROL	
	MEAN	**SD**	**MEAN**	**SD**
Outcome Variables				
BDI-Total	*T1:* 8.98*(10.08)* *T2:* 6.91*(10.07)*		*T1:* 10*(9.61)* *T2:* 10.38*(2.26)*	
BDI-Cognitive Affective	*T1:* 5.86*(7.43)* *T2:* 6.91*(10.07)*		*T1:* 7.68*(7.88)* *T2:* 10.38*(2.26)*	
BDI-Somatic	*T1:* 3.04*(3.34)* *T2:* 2.31*(3.08)*		*T1:* 2.32*(2.19)* *T2:* 3.43*(3.01)*	
CD4 cells/mm^3	*T1:* 422.21*(266.17)* *T2:* 442.61*(306.33)*		*T1:* 462.56*(327.46)* *T2:* 386.50*(249.80)*	
NK cells/mm^3	*T1:* 97.71*(60.26)* *T2:* 88.33*(54.28)*		*T1:* 102.32*(126.55)* *T2:* 62.11*(41.44)*	
Viral Load copies/mm^3	*T1:* 29, 513.48 *(117,239.784)* *T2:* 12,462.90 *(28,331.98)*		*T1:* 21, 358.16 *(37,221.72)* *T2:* 16,911.06 *(24,196.618)*	

SD= Standard Deviation

Table 3

Correlations between CD4+ cells/Natural killer cells and demographics, HIV histor and treatment regimen, health behaviors, and ob/gyn variables at study entry.

	CD4 Cells	NK Cells
Demographics		
Age	*r=−.15*	*r=.30**
Yearly Income	*r=−.08*	*r=−.07*
Education	*r=−.23**	*r=−.05*
Living Status	*r=−.07*	*r=.05*
HIV History and Treatment		
Months Since Dx	*r=−.30**	*r=.07*
NNRTI	*r=−.13*	*r=−.15*
NRTI	*r=−.34**	*r=.06*
MCC	*r=−.11*	*r=−.03*
Protease Inhibitor	*r=.01*	*r=.04*
Health Behaviors		
Recent # Unsafe Sexual Behaviors	*r=.02*	*r=−.13*
Recent Alcohol Use	*r=.09*	*r=−.18*
# Smoking Packs per day	*r=−.08*	*r=−.08*
Marijuana	*r=−.03*	*r=−.13*
Coffee	*r=.12*	*r=−.02*
Vigorous Physical Activity	*r=−.05*	*r=.03*
Sleep Quality	*r=.11*	*r=.09*
Co-Morbidity		
Arthritis	*r=−.23*	*r=−.00*
Cancer	*r=−.12*	*r=−.02*
Asthma	*r=.14*	*r=.24*
Hepatitis	*r=.13*	*r=.09*
OB/GYN		
Cervical Dysplasia at study entry	*r=−.15*	*r=.07*
History of Syphilis	*r=−.14*	*r=−.13*
History of Chlamydia	*r=−.01*	*r=−.12*
History of Genital Herpes	*r=−.04*	*r=.18*
History of Genital Warts	*r=.00*	*r=−.03*
Leukoplakia in Cervix	*r=.13*	*r=−.11*

* p ≤.05; NNRTI= Non-nucleoside reverse transcriptase inhibitor; NRTI= Nucleoside reverse transcriptase inhibitor; MCC= Multi-Class combination

Table 4

Bootstrapping results for the influence of BDI somatic (BDI-S) scores on the relationship between assignment to CBSM and (a) CD4+ T-cells and (b) CD56+ NK cells.

OUTCOME	DIRECT EFFECTS	INDIRECT EFFECTS	
Predictor/Mediator	**b (SE)**[1]	**Estimate**[2]	**$TI_{bootstrap}$**[3]
(a) CD4+ T cells			
CBSM	106.27(56.89)		
BDI-S	−21.39(10.12)	25.93	(3.77, 74.35)
(b) CD56+ NK cells			
CBSM	24.12(11.72)		
BDI-S	−.44(1.92)	.28	(−1.66,7.06)

[1] Predictor to outcome with mediators.

[2] Bootstrapped estimates of indirect effects.

[3] Bias-corrected confidence intervals.