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Perceived stress in HIV-infected individuals: Physiological and psychological correlates

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Abstract
The purpose of this study was to determine the correlation of perceived stress with selected physiological and psychological factors in an HIV-infected, predominantly African American population and to assess the multivariable effects on perceived stress. The variables that correlated significantly with perceived stress were entered into a backward stepwise regression model. Pearson's *r* analysis showed significant correlations between perceived stress and state and trait anxiety, depression, HIV-related symptoms, sleep quality, daytime sleepiness and fatigue. State and trait anxiety, depression and fatigue retained significance ($p < 0.1$) in the final regression model. These factors explained approximately 80% of the variance in perceived stress. The significant interactions of multiple physiological and psychological correlates suggest that perceived stress is a complex outcome with a multifactorial etiology. Further, the model suggests that psychological factors may contribute to perceived stress in this population more than physiological factors such as HIV-related symptomatology or stage of disease.

Introduction

HIV disease is a major source of emotional and physiological stress for those who are infected (Faulstich, 1987). Chronic exposure to stressful events reduces immunity, contributes to increased symptomatology and hastens disease progression to AIDS (van Eck et al., 1996). Further, it appears that the physiological and immunological responses to potentially stressful events are due primarily to the individual's assessment of the event, the perceived stress.

Perceived stress is a complex concept with all indications of an etiology that is multifactorial. The purpose of this study was to determine the physiological and psychological correlates of perceived stress in a sample of HIV-infected men and women. Another goal was to establish the differential effects of those correlates on the level of perceived stress in the sample. Variables of interest were selected from a psychoneuroimmunological model that suggests multidirectional interactions among psychological factors such as anxiety and depression, environmental stressors such as number of adults and children in the home and physiological variables including level of HIV-related symptomatology, sleep quality and HIV-RNA viral load.

The relationship between stress and anxiety has been demonstrated through reports of decreased anxiety in HIV-infected individuals following stress management therapy (Lutgendorf, et al., 1997; Taylor, 1995). Depression and anxiety are the two most common psychological symptoms present in the HIV-infected population and are associated with increased symptom frequency and accelerated progression to AIDS (Cabaj, 1996; Ickovics et al., 2001). Studies have demonstrated that the symptoms of depression in HIV-infected subjects can be reduced using techniques for stress reduction (Antoni et al., 1991b; Lutgendorf et al., 1997). Social support is a primary mediator of perceived stress and can lessen feelings of emotional distress and enhance health outcomes in those infected with HIV (Crosby et al., 2001; Hudson et al., 2001; Solomon, & Temoshok, 2002). However, social support is a complex concept, as demonstrated by reports that the presence of a partner or close friends, rather than simply being around family members or others, is associated with perceived social support and reduced stress levels (Burgoyne & Saunders, 2000).

HIV infection is accompanied by several physical symptoms that have the potential to adversely affect quality of life (Cunningham et al., 1998). Interestingly, some data suggest that HIV-infected individuals who participate in stress management activities improve in physical health, as well as mental health and quality of life (Gielen et al., 2001). Physical fatigue is a common symptom of HIV-infected individuals and is associated with anxiety and depression (Adinolfi, 2001; Groopman, 1998). Studies from our group

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and others indicate that perceived stress is a significant psychological determinant of fatigue (Robbins et al., 2004). A common symptom of HIV that is highly related to fatigue is increased daytime sleepiness secondary to night time sleep disturbance (Hand et al., 2003; Phillips et al., 2004). HIV-infected individuals categorized as poor sleepers have lower scores than good sleepers on all SF-36 dimensions and health-related quality of life (Phillips et al., 2004).

Methods

Sample

The sample consisted of 79 HIV-infected women and men recruited from a local primary health care association. Infected individuals who were 18 years of age or older, able to read and understand English at a sixth grade level and receiving health care services at the primary health care association were included in the study. Potential subjects were excluded if they reported using illicit drugs, misusing prescription drugs or taking anti-depressant or anxiety drugs in the previous six months.

Procedure

After signed informed consent, individuals gave consent for the primary health care practice to release their laboratory results (HIV-RNA viral load and T helper cell (CD4+) count) to the researchers. Data were collected using a structured self-report questionnaire, which was completed on the same day the blood for laboratory tests was drawn. The Office for Research Protection at the University of South Carolina approved the study and its procedures prior to any data collection.

Instruments

Table I lists the instruments used in this study and includes the range of potential scores for each instrument.

Demographic data form. Participants were asked to report standard demographic variables such as age, race and HIV-related variables such as route of infection, stage of illness, symptoms, antiretroviral and hematinic medications.

Perceived stress scale (PSS). The 30-item PSS (Levenstein et al., 1993) yields a total score for perceived stress and seven subscale scores. Reported internal consistencies were greater than 0.90. The total score was used as the measure of perceived stress in this study.

Spielberger's state-trait anxiety inventory (STAI). The STAI (Spielberger et al., 1971) is a 40-item instrument that measures state anxiety (transitory) and trait anxiety (relatively constant anxiety proneness). The state and trait anxiety scales have reported internal consistencies ranging from 0.83–0.92 and 0.86–0.92 respectively.

Center for Epidemiological Studies Depression scale (CES-D). The CES-D measures depression on a four-point, 20-item scale (Radloff, 1977). The participants were asked to rate how often in the past week they had experienced a depressive symptom represented by each of the 20 items. Reported internal consistencies for the instrument have ranged from 0.83–0.90.

HIV-related symptom scale (HSS). The HSS was used to measure the frequency of HIV-related symptoms. This instrument is comprised of 19 physical symptoms that are commonly experienced by HIV-infected individuals. The HSS asked participants to rate how much of the problem each of the symptoms had been for them during the past month. A higher summary score indicated that an individual was experiencing a greater frequency of HIV-related symptoms. Reliability was supported in this sample with a Cronbach's alpha of 0.87.

Table I. Psychological, physiological and demographic measurements.

Instrument	Mean	SD	Potential range	Actual range	Alpha
1. Perceived Stress Scale	68	19.2	0–120	2–114	0.95
2. Spielberger's State Anxiety Inventory	40.9	13.6	20–80	20–78	0.92
3. Spielberger's Trait Anxiety Inventory	45.2	11.4	20–80	20–74	0.91
4 CES-Depression	22.3	11.3	0–60	1–47	0.87
5. HIV-related symptoms	31	10.4	17–68	17–50	0.87
6. Pittsburgh Sleep Quality Index	12.3	3.9	0–21	5–21	0.77
7. Epworth Daytime Sleepiness Scale	8.4	5.9	0–24	0–22	0.84
8. Piper Fatigue Scale	3.9	2.8	0–10	0–9.9	0.98
9. CD4+ cell count (cells-mm^3)	412.4	268.3	N/A	8–1140	N/A
10. HIV-RNA viral load	38,577	83,621	N/A	25–516,000	N/A
11. Number of adults in the home	1.1	1.2	N/A	0–5	N/A
12. Number of children in the home	1.7	1.8	N/A	0–13	N/A

Revised Piper fatigue scale (RPFS). The RPFS was used to measure subjective fatigue. The RPFS consists of 22 items that are summed to give the total fatigue score used in this study as the measure of subjective fatigue (Piper, 1989). The RPFS demonstrates internal consistency with a Cronbach's alpha of 0.97.

Pittsburgh sleep quality index (PSQI). The PSQI contains 19 self-report items and yields a total sleep quality score and seven component scores including quality and daytime dysfunction (Buysse et al., 1991). The total sleep quality score was used to measure sleep quality with a higher score indicating poorer sleep quality. The total sleep quality score has a reported internal consistency of 0.83.

Epworth daytime sleepiness scale (ESS). The total score for the ESS was used to measure daytime sleepiness (Johns, 1991). This scale asked individuals to rate how likely they were to doze off or fall asleep in eight specific situations. The total score for the ESS has a reported reliability of 0.83.

Data analysis

Table I reports frequencies and percentages that were calculated for each of the sociodemographic variables. Reliabilities for each of the research instruments were estimated using Cronbach's alpha reliability coefficient. Tabulation of simple descriptive statistics including means, medians, ranges and standard deviations was performed for all responses to each instrument or scale. All data are reported as mean $\pm$ standard deviation.

Bivariate correlations. Bivariate correlations were calculated among the study variables using Pearson's coefficient of correlation (Pearson's r).

Backward stepwise elimination. A backward stepwise regression procedure was performed that included all seven variables that were determined to correlate significantly with perceived stress. Statistical significance was set at $p < 0.1$. Because multicollinearity is a confounder for regression analyses, collinearity diagnostics were performed for each of the variables in the full model.

Results

Demographic characteristic

All 79 participants in this study had documented HIV serostatus. They were predominately African Americans ($n = 70$, 90%) with five Caucasians (6%), three Hispanics (4%) and one missing data point. Forty-two (53%) of the participants were women and 37 (47%) were men. The majority of the participants were single ($n = 64$, 82%) with the remaining 14 participants (18%) reporting some type of partnership, with one data point missing. The age ranged from 24 to 63 (39.9 ± 7.8). Thirteen participants were asymptomatic, 25 participants were symptomatic and 18 had developed AIDS. Twenty-three participants did not report their disease stage. Fifty-six (73%) participants were receiving combination antiretroviral therapy. An independent samples T-test indicated no difference ($t = 0.50$, $p = 0.62$) in perceived stress between participants who were and were not receiving combination antiretroviral therapy.

Comorbidity was examined in this sample. Ten subjects reported being treated for hypertension. Nine participants were treated for depression. Eight participants were treated for gastroesophageal reflux disease. Five participants were treated for diabetes mellitus, two of whom received insulin. All five of the diabetics received oral hypoglycemics. Two participants were being treated for dyslipidemia. Three participants were receiving appetite stimulants. Eight males and twelve females were anemic. Two participants reported taking erythropoietin, five participants took iron supplements and fifteen participants reported taking multiple vitamins.

Perceived stress. Table I summarizes the perceived stress findings. The data were distributed normally, with 56 (72%) of the participants presenting a score of greater than 60, the median score for the PSS. Only one subject scored less than 30 on the scale.

Correlates of perceived stress. Table I lists the specific findings for each of the variables measured, while Table II describes the bivariate correlation of each variable with perceived stress. The subjects reported relatively high levels of state and trait anxiety, with mean scores above the median score for the two anxiety scales. Further, both state and trait anxiety showed statistically high correlations with perceived stress. Depression scores covered a wide range from virtually no depression to scores that were 78% of the maximal possible score. The mean score was twice the high end of the normal range of scores observed in non-clinical populations (scores of 2–10). Over 75% of the subjects reported scores of 16 or greater, which is a score that is consistent with a clinical diagnosis of depression. Depression correlated significantly with perceived stress. The majority of subjects (84%) reported a significant amount of HIV-related symptomatology. As described in Table III, the HIV-related symptom scores correlated significantly with perceived stress. All subjects reported pathological sleep disturbances and daytime dysfunction in the previous month. However,

Table II. Bivariate correlations using Pearson's *r*.

Variable	*r*	*p*
1. State anxiety	0.77	<0.0001
2. Trait anxiety	0.80	<0.0001
3. Depression	0.80	<0.0001
4. HIV-related symptoms	0.54	<0.0001
5. Sleep quality	0.41	0.002
6. Daytime sleepiness	0.34	0.003
7. Fatigue	0.71	<0.0001
8. CD4+ cell count	−0.07	0.62
9. HIV-RNA viral load	0.16	0.25
10. Number of adults in the home	0.06	
11. Number of children in the home	0.02	

sleeping medication was not used by 53% of the participants. Fatigue scores ranged from zero to the maximal discernable score (9.9 out of 10) and correlated highly with perceived stress. Disease status, as measured by HIV-RNA viral load or CD4+ cell count, did not correlate with perceived stress. Further, neither the number of adults nor the number of children in the home were correlated with perceived stress or any other measured variable.

Correlates of HIV-related physical symptoms. As described in Table I, the subjects reported relatively high levels of physical symptomatology. Bivariate correlation analysis for the total physical symptom score against the total score for each of the measured variables indicated a number of significant correlations. Total HIV-related physical symptoms showed a significant correlation with psychological and physiological variables including depression ($r=0.49$, $p=0.0001$), sleep quality ($r=0.36$, $p=0.004$), fatigue ($r=0.57$, $p<0.0001$) and total pain ($r=0.53$, $p<0.0001$).

Table III. Significant Pearson Correlations for perceived stress and HIV-related physical symptoms.

Variable	*r*	*p*
1. Persistent fatigue	0.6	<0.0001
2. Diarrhea	0.41	0.001
3. Weight loss	0.44	0.0004
4. Night sweating	0.36	0.0048
5. Burning, tingling in feet	0.28	0.027
6. Aching and soreness in legs	0.34	0.0069
7. Weakness	0.7	<0.0001
8. Cold sores, fever blisters	0.35	0.0051
9. Genital sores	0.33	0.008
10. Skin discoloration	0.26	0.042
11. Abnormal PAP smears	0.32	0.043
12. Vaginal infection	0.33	0.034

Backward stepwise regression. Table IV describes the outcome of the regression procedure. Significant or borderline significant factors were trait anxiety ($p=0.0006$), depression ($p=0.0065$), fatigue ($p=0.0104$) and state anxiety ($p=0.083$). All variance inflation factors were <10 and the condition inflation factors were <30, indicating that multicollinearity did not impact this model. Statistical power was calculated to be 0.80 with a medium effect size in this sample.

Discussion

The purpose of this study was to determine the physiological and psychological correlates of perceived stress in a sample of HIV-infected men and women. A secondary goal was to establish the unique effects of the measured correlates on the level of perceived stress in the sample. The results indicate a very significant correlation between perceived stress and each of the following variables: state and trait anxiety, depression, HIV-related symptoms, sleep quality and daytime sleepiness and fatigue. A backward stepwise regression analysis underscored the impact of mood as state and trait anxiety, depression and fatigue emerged as significant components in the multivariate model.

Disease status is a major source of stress for HIV-infected individuals (Faulstich, 1987; Morin et al., 1984). Personal and environmental factors such as HIV serostatus and viral load, HIV-related symptoms and hassles of daily living are widely reported as adding significantly to the individual's level of stress (Cohen et al., 2002; Howland et al., 2000; Leserman, 2000). The evidence indicates that chronic exposure to stressful events reduces immunity, contributes to increased symptomatology and hastens disease progression to AIDS (Goodkin et al., 1996; van Eck et al., 1996). However, evidence suggests that the physiological and immunological responses to potentially stressful events are due primarily to the individual's assessment of the event, the perceived stress, rather than the event itself. This assessment and resultant coping strategy, is a multistage cognitive evaluation with differing behavioral outcomes (Fleishman & Fogel, 1994; Moneyham et al., 1998). For example, several studies indicate that the level of perceived stress, rather than the nature of the stressor, determines the intensity of the stress response. A number of studies have concluded that HIV-infected individuals with high levels of perceived stress typically have poorer stress management skills and less appropriate coping mechanisms (Cruess et al., 1999; Koopman et al., 2000; Tuck et al., 2001). Further, low perceived stress scores are associated with long-term survival in HIV-infected individuals (Balbin et al., 1999).

Table IV. Backward Stepwise Regression Analysis for variables associated with perceived stress.

Variable	β	SEB	F	*P*
Intercept	19.8	4.42	19.91	<0.0001
Trait Anxiety	0.56	0.15	13.06	0.0006
Depression	0.42	0.15	7.88	0.0065
Fatigue	1.4	0.53	6.94	0.0104
State Anxiety	0.22	0.13	3.1	0.0830

Note: $R^2 = 0.80$; Model F4, $68 = 66.82$, $p < 0.0001$; $N = 72$

The prevalence of anxiety disorders is higher with HIV infection as compared to non-infected individuals (Perkins et al., 1995) and has a detrimental effect on physical health, physical functioning, sleep and mood (Lutgendorf et al., 1998; Nokes & Kendrew, 2001). Results from the current study show that two of the strongest and most highly significant correlations were between perceived stress and state anxiety and perceived stress and trait anxiety. The relationship between stress and anxiety has been demonstrated with reports that stress management programs decrease self-reported anxiety in HIV-infected individuals when compared to infected control groups (Lutgendorf et al., 1997; Taylor, 1995). Both state and trait anxiety retained significance ($p < 0.1$) in a four-component backward stepwise regression that explained 80% of the variance in perceived stress. Further, since trait anxiety was the most significant predictor of perceived stress, a genetic component of anxiety-associated personality may have an interaction with the environmental stressors associated with HIV infection. The possibility that anxiety partially accounts for the etiology of stress or that the relationship is bi-directional in the HIV-positive population warrants additional research.

As with anxiety, we found a very significant correlation between perceived stress and self-reported depressive symptoms. Further, depression also retained significance in the multivariate regression model. Depression and anxiety are the two most common psychological symptoms present in the HIV-infected population (Cabaj, 1996). Depression has a significant impact in HIV-infected individuals because it is associated with immunosuppression, increased symptom frequency and accelerated progression to AIDS (Ickovics et al., 2001). Several groups have demonstrated that the symptoms of depression in HIV-infected subjects can be reduced using techniques for stress reduction (Antoni et al., 1991a; Lutgendorf et al., 1997).

Chronic HIV infection is accompanied by physical symptoms that have the potential to adversely affect quality of life. There is an inverse relationship between physical symptoms (fever, night sweats, myalgia, fatigue, anorexia, nausea and vomiting) and their self-reported health-related quality of life component scores (Cunningham et al., 1998). In the present study, HIV-related physical symptoms were significantly associated with mood, sleep and fatigue and total pain. Interestingly, some data suggest that HIV-infected individuals who participate in stress management activities improve physical as well as mental health and quality of life as compared to patients who do not participate in the interventions (Gielen et al., 2001).

Fatigue is a common finding in HIV-infected individuals and is associated with physical symptoms and decreased physical functioning (Adinolfi, 2001; Groopman, 1998). A previous study from our group indicated that the characteristic that emerged as the most significant psychological determinant of fatigue was perceived stress (Phillips et al., 2004). In addition, Breitbart et al. (1998) determined that HIV-infected patients with fatigue report a greater than normal degree of overall psychological distress. The results from the present study show a correlation between fatigue and perceived stress, as well as correlations between fatigue and anxiety and depression. Further, fatigue emerged as a significant component of the regression model for perceived stress. Clearly, these conditions are interrelated. Studies indicate that various stress management interventions can reduce fatigue in HIV-infected individuals (Eller, 2001). These interventions range from almost purely psychological therapies, such as guided imagery or hypnosis, to treatments that are based more on physical stimulation, such as progressive muscle relaxation.

Increased daytime sleepiness, secondary to sleep disturbance, is a typical presenting symptom of HIV infection. Our group found in a previous study that all participants in a convenience sample of HIV-infected individuals showed a clinically significant level of sleep disturbance (Hand et al., 2003). Sleep disturbance in HIV-positive individuals is negatively associated with physical and mental health status (Phillips et al., 2005; Robbins et al., 2004). Data from the current study indicate that both sleep quality and daytime sleepiness correlate significantly with levels of perceived stress. While little information is available concerning the effects of stress management on sleep parameters, our group showed recently that stress management through acupuncture therapy significantly improved sleep quality in HIV-infected subjects (Phillips & Skelton, 2001).

Social support is a primary mediator of perceived stress and can lessen feelings of emotional distress and depressive symptoms in those infected with HIV (Crosby et al., 2001; Hudson et al., 2001). However, data from the present study show no correlation between number of adults in the home and any of the measured physiological or psychological vari-

ables. Further, no correlations were shown with number of children in the home. Our findings are similar to those of Burgoyne and Saunders (2000), who found that the presence of a partner and a greater proportion of close friends, rather than close family, were associated with better ratings of perceived social support. Together, these data indicate that social support is a multidimensional construct and simply being around people does not, in itself, convey the support needed for stress reduction. The relationship between stress and social support is especially important for HIV-infected individuals, as stress levels can directly affect health outcomes and the length of survival (Solomon & Temoshok, 2002).

Individuals participating as subjects in this study consisted of predominantly African American men living in the urban environment of a city of medium size. Therefore, extrapolation of these findings to other populations must be done with caution. We suggest that different findings might be measured in populations from large metropolitan or rural areas. As with any cross-sectional correlational study, causal relationships cannot be established.

Conclusions

In conclusion, results from the present study indicate that both physiological and psychological variables correlate significantly with perceived stress in a population of HIV-infected individuals. Physiological correlates include HIV-related symptoms such as pain, fever and oral infections. Fatigue and weakness were also correlated with perceived stress. Psychological correlates included state and trait anxiety and depression. Sleep quality and daytime sleepiness, variables containing both physiological and psychological components, also correlated with perceived stress. A predictive model for perceived stress was established for the population that included trait anxiety, depression, fatigue and state anxiety. The multiple physiological and psychological correlates suggest that perceived stress is a complex syndrome with a multifactorial etiology. Future research will endeavor to determine the directional interaction of the variables that showed significant relationships to stress.

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