Aerobic Exercise Training for Depressive Symptom Management in Adults Living With HIV Infection

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Aerobic exercise training may help prevent or reduce depressive symptoms experienced by persons living with HIV infection. However, the psychological effects of aerobic exercise have not been studied extensively. This study evaluated the effects of an aerobic exercise training program on self-reported symptoms of depression in HIV-infected adults and examined the convergent validity of two widely used depressive symptom scales. Sixty HIV-infected adults participated in a randomized, controlled trial of a supervised 12-week aerobic exercise training program. As compared to study controls, exercise participants showed reductions in depressive symptoms on all indices, and total depressive symptoms scores were highly correlated. Additional study of the psychological effects of aerobic exercise programs in the target population is recommended.

Key words: HIV, exercise, depression, symptom

Depression is the most common reason for psychiatric evaluation and treatment of persons living with HIV infection. Researchers have estimated the prevalence of major depression in HIV-infected persons in clinical settings to be between 22% and 32% (Brown et al., 1992; Evans et al., 1998; Ferrando et al., 1998; Rabkin, 1997; Williams, Rabkin, Remien, Gorman, & Ehrhardt, 1991). These estimated rates are approximately twice the observed rate in the general community population (Kessler et al., 1994). However, prevalence differences have been less pronounced when HIV-positive and HIV-negative subpopulations (gay men, intravenous drug users) were compared in studies including control groups (Lipsitz et al., 1994; Rosenberger et al., 1993). In the first nationally representative sample of adults receiving care for HIV infection in the United States, more than one third of adults screened positive for major depression during the previous 12 months (Bing et al., 2001).

Although the 1996 probability sample (Bing et al., 2001) predates the widespread use of more highly active antiretroviral therapies, persons living with HIV continue to face considerable psychological challenges. Distressing physical symptoms (Bonfanti et al., 2000; Carr et al., 1998) and considerable psychological demands often accompany these lifetime regimens (Chesney, Morin, & Sherr, 2000). Researchers who reported a significant reduction in depressive symptoms with protease inhibitor antiretroviral therapies also noted that 46% of patients continued to have significant levels of depressive symptoms 1 year after treatment with these more powerful antiretroviral medications. Patients in these studies also noted that certain medications and regimens were associated with increased feelings of depression.

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DOI: 10.1177/10553290002250992
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effective anti-HIV drug regimens (Low-Beer et al., 2000). One group reported significant levels of depressive symptoms in 52% of individuals who had not yet initiated anti-HIV drug regimens (Low-Beer et al., 2000).

With the lengthening course of HIV illness, the prevention and management of depressive symptoms have important personal and public health benefits. Although consensus is lacking, some have reported more rapid immune decline and accelerated mortality in persons with HIV infection reporting higher levels of depressive symptoms (Burack et al., 1993; Mayne, Vittinghoff, Chesney, Barrett, & Coates, 1996). Depression is also thought to negatively affect quality of life more than most medical conditions (Hays, Wells, Sherbourne, Rogers, & Spritzer, 1995). Among adults with HIV infection, Sherbourne et al. (2000) found that those with symptoms of depression or other probable mood disorders had significantly lower health-related quality-of-life scores than did those without depression. Suicide ideation is an important depressive symptom that must be carefully assessed in persons with HIV infection. Marzuk et al. (1988) demonstrated dramatic reductions in suicide rates in HIV/AIDS samples. However, as Levine (2001) astutely commented, the improved HIV/AIDS therapies that have reduced suicide among persons living with HIV infection have also led to new stressors. Requirements for lifetime adherence to complicated therapies and HIV risk behavior modification (Rabkin & Ferrando, 1997) as well as the need to renegotiate feelings of hope and new social roles (Brashers et al., 1999) present new challenges for persons once reconciled to a death from HIV/AIDS.

Beyond the compelling need to manage depressive symptoms to ameliorate personal suffering, effective management of depression may also promote HIV drug adherence and help to minimize HIV transmission. Depression has been associated with non-adherence to HIV drug regimens (Gordillo, del Amo, Soriano, & Gonzalez-Lahoz, 1999; Singh et al., 1999) and may be associated with increased sexual risk behaviors, although findings associating negative affect (depression, anxiety, anger) with sexual risk behaviors have been mixed (Kalichman, 1999). In a recent meta-analysis, Crepaz and Marks (2001) concluded there is little evidence that negative affect is associated with increased sexual risk behavior. However, Kalichman and Weinhardt (2001) argued this is not an unexpected finding when the aggregate literature is examined given methodological shortfalls in the original studies. Because partial adherence to complex HIV drug regimens may lead to drug resistance (Vanhove, Schapiro, Winters, Merigan, & Blaschke, 1996) and because prevalence of drug resistance in primary HIV infections is increasing (UK Collaborative Group on Monitoring the Transmission of HIV Drug Resistance, 2001), additional research into the impact of depression on adherence and sexual risk taking is needed.

Effective drug therapy for clinically depressed HIV-infected persons is available (e.g., Rabkin, Wagner, & Rabkin, 1999). Selection from among traditional (tricyclic, selective serotonin reuptake inhibitors) and alternative agents (dextramphetamine or testosterone replacement) is often aimed at minimizing cumulative side effects of antiretroviral and antidepressant regimens and time to clinical response. However, despite available drugs and psychotherapy, depressive symptoms in this population often are not treated (Sambamoorthi, Walkup, Olsson, & Crystal, 2000). Providers may view depressive symptoms as a normal component of the underlying HIV disease or HIV therapy (Rabkin, 1997).

In addition, depressive symptoms consistently correlate with physical symptom reports (Rabkin et al., 1997), and the overlap between symptoms of the viral infection, related neuropsychological symptoms, and depressive symptoms (e.g., fatigue, poor appetite, weight loss, trouble concentrating) has made selecting a measure of depressive symptoms difficult. Because there is no HIV-disease-specific measure of depression symptoms, many researchers, including those studying the largest cohorts (Burack et al., 1993; Mayne et al., 1996; Ostrow et al., 1989), have assessed depressive symptoms with the Center for Epidemiological Studies–Depression Scale (CES-D) (Radloff, 1977). This scale is thought to be less confounded by physical symptoms (Drebing et al., 1994). On the other hand, a considerable number of researchers (e.g., Singh, Squier, Sivek, Wagener, & Yu, 1997) have collected self-reported symptoms of depression within HIV and AIDS studies using the Beck Depression Inventory (BDI). The BDI is a symptom measure...
originally intended as a clinical index of depression severity (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). To overcome symptom confounds, some HIV/AIDS researchers have developed CES-D subscales (Burack et al., 1993; Ostrow et al., 1989), whereas others have used the total scale and controlled for symptoms during analysis (Lyketsos et al., 1993). This inconsistent use of symptom indices, concern about symptom confounds, and divergent scoring approaches have limited interpretation of this body of research.

Aerobic exercise training is also associated with decreased depression in health and chronic illness (Dishman, 1985). In HIV-negative persons, regular exercise has been shown to be an effective therapy for mild to moderate depression and an efficacious adjunct for severe depression (Morgan & Goldston, 1987; Tkachuk & Martin, 1999). In controlled studies of clinically depressed patients, aerobic exercise training has been consistently shown to be more effective than no treatment or placebo control and to have favorable efficacy when compared to psychotherapy and cognitive therapy (Tkachuk & Martin, 1999). As compared to traditional depression treatments, exercise therapy may be more cost-effective (Greist et al., 1979). As such, aerobic exercise may be a cost-effective way for HIV-positive persons to prevent or reduce mild to moderate symptoms of depression. In light of potential antiretroviral and antidepressant drug interactions (Rabkin, 1997), exercise may also be an important drug adjunct for more severely depressed persons.

Aerobic exercise is one of the most frequently reported alternative and complementary activities used by HIV-infected persons (Greene et al., 1999). Results from small, controlled studies also suggest that HIV-infected persons may engage in habitual moderate-intensity exercise to improve cardiopulmonary fitness without clinically significant CD4 lymphocyte cell decreases (MacArthur, Levine, & Birk, 1993; Rigsby, Dishman, Jackson, Maclean, & Raven, 1992; Smith et al., 2001; Stringer, Berezovskaya, O’Brien, Beck, & Casaburi, 1998) or undesired increases in plasma HIV viral load (Smith et al., 2001; Stringer et al., 1998). Mental health outcomes, however, have not been studied as extensively, and the effects of chronic exercise on depressive symptoms have not been isolated.

Using Profile of Mood State (POMS) scores, LaPerriere and colleagues (1990, 1991) concluded that aerobic exercise training attenuated stressors associated with receipt of an HIV-positive test result. Others (MacArthur et al., 1993) noted a trend to improvement on an unspecified mental health questionnaire, and Lox, McAuley, and Tucker (1995) reported improved mood in HIV-infected exercisers as compared to study controls. Wagner, Rabkin, and Rabkin (1998) also reported mood enhancement when exercise was combined with steroid therapy. Overall, these findings have been limited by small samples, limited control for disease stage and concomitant drugs, variable exercise protocols (Smith et al., 2001), and the use of diverse mental health measures.

The current study examines the efficacy of aerobic exercise training for the management of depressive symptoms experienced by adults living with HIV infection. The purpose of this study was to (a) determine the impact of participation in a 12-week aerobic exercise training program on self-reported depressive symptoms and (b) to examine the correlations among participant scores on several widely used measures of depressive symptoms and depressed mood. The researchers hypothesized that the experimental group, as compared to the study controls, would have improved Week 12 CES-D, BDI, and POMS depression subscale scores.

**Method**

Study data were collected between 1995 and 1998 as part of a larger study examining aerobic exercise training for HIV symptom management (Smith et al., 2001). Participants were randomly assigned to a 12-week aerobic exercise training or to a wait list (maintain usual activity) condition within a pretest/posttest control group design. The study received prior approval by the institutional review board, and informed consent was obtained. Participants were exercise tested in a university health and wellness center and mainstreamed for training into university staff and patient fitness programs at the same facility. Other procedures were performed at the university’s AIDS Clinical Trials Unit (ACTU). A convenience sample of 60 adults who had laboratory-confirmed HIV
infection and met Centers for Disease Control and Prevention (CDC) disease classifications A2 (asymptomatic, non-AIDS) or B2 (symptomatic, non-AIDS) (CDC, 1993) was recruited from the ACTU and the local community. If participants were taking antiretrovirals or antidepressants at screening, regimens were stable for at least 8 weeks. During screening, all participants were examined and cleared medically by an ACTU physician.

Exercisers were required to attend three supervised 1-hour training sessions per week. Trained exercise leaders coached participants to exercise a minimum of 30 minutes within an individually prescribed target heart rate range corresponding to 60% to 80% of maximum oxygen uptake (VO₂ max). Personal trainers supervised the exercise sessions conducted in a medical exercise facility with nurse practitioners, exercise physiologists, and physicians in attendance. Participants chose an aerobic exercise modality from among treadmill use, stationary biking, and walking. Further details of the inclusion/exclusion criteria, exercise testing and training protocols, and participant monitoring are reported elsewhere (Smith et al., 2001).

Measures

Dependent measures were collected at Weeks 0 and 12. Only exercise participants who completed at least 28 of 36 sessions and attended at least 80% of sessions during the month prior to the graded exercise posttest were included in these analyses.

CES-D. The CES-D is a 20-item self-report measure of symptoms commonly associated with depression. The scale emphasizes affective distress and was not intended as a diagnostic measure of clinical depression (Radloff, 1977). Respondents rate the frequency of symptoms experienced in the past week on a 4-point scale; each item receives a score from 0 to 3, and total scores range from 0 to 60. Scores greater than 16 indicate a high level of depressive symptoms and have good sensitivity in predicting a clinical diagnosis of depression (Weissman, Prusoff, & Newberry, 1975). High internal consistency, concurrent validity with self-report and clinical interviews, and construct validity have been established (Radloff, 1977); reliability (Cronbach’s alpha = .90) has been established in HIV/AIDS samples (DeGenova, Patton, Jurich, & Macdermid, 1994); reliability estimates for administrations of the CES-D and other dependent measures in this sample are reported in bold in Table 1.

BDI. The BDI is a self-report depressive symptom index that includes 21 items. Participants rate each symptom on severity, and individual items are scored from 0 to 3. Total scores range from 0 to 63, and a score of 9 is thought to be indicative of at least mild depression. A score of 15 is designated as a possible depression cutoff in the general population (Beck & Steer, 1993). Concurrent validity with other measures of depression, internal consistency, and instrument stability have been demonstrated (Beck & Steer, 1993); the BDI has been frequently used by researchers examining the effects of exercise on depression (Tkachuk & Martin, 1999).

POMS. The POMS is a 65-item instrument measuring six mood states: tension/anxiety, depression/dejection, anger/hostility, fatigue/inertia, confusion/bewilderment, and vigor/activity (McNair, Lorr, &
Droppleman, 1971). Respondents rate the occurrence of adjective items during the past week on a 5-point scale from 0 (not at all) to 4 (extremely). With the exception of the vigor subscale, higher scores indicate a negative mood state. Internal consistency estimates of 0.90 or greater have been reported for all six mood scales, and test-retest reliabilities have been estimated at 0.65 to 0.74. Construct and predictive validity using other measures of depression, anxiety, and distress have been established (McNair, Lorr, & Droppleman, 1992), and excellent reliability for the entire scale and the 15-item depression subscale (Cronbach’s alpha = .93) has been reported in HIV samples (e.g., Perkins et al., 1995).

**Other Variables**

A number of potentially confounding or explanatory variables were assessed at Weeks 0 and 12 in the larger exercise study (Smith et al., 2001). These included measures of physical fitness, physical activity outside the exercise study, stress, social support, and HIV-related medical history and self-reported symptoms.

**Physical fitness.** Aerobic fitness or peak aerobic power (VO2 max) was measured during graded exercise testing on a motor-driven treadmill. Testing followed guidelines adapted from American College of Sports Medicine (ACSM) (2000) standards for exercise testing and was done in a controlled laboratory setting by staff members experienced with exercise testing in clinical populations.

**Physical activity.** General physical activity (during the prior 2 weeks) was measured at baseline and at Week 12 using an adaptation of an instrument originally designed by Paffenbarger, Wing, and Hyde (1978). Participants in both groups were asked to report the number of hours they spent in light, moderate, or vigorous activity. These data were desired to identify changes in moderate or vigorous nontraining physical activity that might influence study outcomes.

**Stress.** The Perceived Stress Scale 4 (PSS 4) (Cohen, Kamarck, & Mermelstein, 1983) measures the degree to which an individual appraises life situations as stressful. Items are scored from 0 to 5, with higher scores indicating greater perceived stress. The PSS 4 is thought adequate when a brief stress measure is desired (Cohen & Williamson, 1988). In the general population, a mean of 4.49 (± 2.96) has been reported. Both the Social Support Questionnaire–6 (SSQ-6) and the PSS 4 have been used in HIV/AIDS samples; estimated reliabilities in this sample ranged from 0.82 to 0.84.

**Social support.** The SSQ-6 (Sarason, Sarason, Shearin, & Pierce, 1987) is a widely used six-item self-report that measures perceived access to supportive others and individual satisfaction with the perceived support. Higher scores indicate higher levels of perceived access and satisfaction. Across administrations, reliabilities in this sample ranged from 0.77 to 0.91 for the number scale and 0.93 to 0.96 for the satisfaction scale.

**HIV medical history.** When interviewing participants about their current medications and other medical history, trained ACTU research nurses used standardized data collection tools that are widely used across AIDS Clinical Trials Group protocols. Self-reported symptoms were assessed using an HIV symptom checklist (Smith et al., 2001). Demographics, HIV risk behaviors, and other drug use patterns were also self-reported.

**Data management and analysis.** Investigators reviewed case record forms for missing and aberrant data. Data were quality controlled using standard ACTU procedures and were analyzed using SPSS for Windows computer program (SPSS 10.0) with an alpha level of .05 specified prospectively. Chi-square analyses or two-tailed Fisher’s exact tests and univariate analysis of variance (ANOVA) models were used to assess pretreatment group equivalence. Means and standard deviations were calculated, and distributions were examined for all dependent variables. Analysis of covariance (ANCOVA) procedures were used to assess between-group changes after treatment using pretest measures as the covariate. Finally, Pearson product-moment coefficients were used to describe the relationships between mean scores on dependent measures.
Results

Sample Description

Baseline demographic and clinical participant characteristics are reported in Table 2. Treatment groups were balanced on depressive symptoms and all demographic and clinic characteristics except race. Significantly more Blacks were assigned to the exercise condition, \( \chi^2(1, N = 60) = 5.45, p = .02 \). The majority of study participants were Caucasian men. Most participants had attended college.

The mean CD4 count for the study sample was 347 ± 87 cells/mm\(^3\), and on average, participants had known of their HIV infection for more than 4 years. More than 75% of the participants were taking anti-HIV drugs, although protease inhibitor use was not yet common (used by <15% of participants). At baseline, 20% of the participants using the BDI and 35% of participants using the CES-D reported significant levels of depressive symptoms (see Table 3). Because study groups were also balanced on a number of potentially confounding variables (e.g., social support, perceived stress, HIV-related symptoms), these variables were not controlled in subsequent analyses.

Participant Attrition/Assessment of Bias

Overall, 48 (80%) of 60 participants completed the study. All control participants were retained; however, 12 (40%) of 30 exercisers prematurely discontinued participation for a variety of reasons. To assess for bias, exercisers who completed the program were compared to those who prematurely quit (see Table 4). Significantly more women (Fisher’s exact test, \( p = .02 \)) and African Americans (Fisher’s exact test, \( p = .01 \)) prematurely discontinued study participation, and significantly more smokers than nonsmokers completed the 12-week exercise program (Fisher’s exact test, \( p = .01 \)). Although we suspected that escalating symptom burden might contribute to participant attrition, exercisers who completed the study were not significantly different from noncompleters on reported symptom distress, and the exercise participants did not report significantly more symptoms at Week 12 as compared to study controls (data not reported).

Table 2. Baseline Participant Characteristics

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<th>Sample</th>
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<td>(n = 60)</td>
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<tr>
<td>n %</td>
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<tr>
<td>Female</td>
<td>8 13</td>
<td>4 13</td>
<td>4 13</td>
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<tr>
<td>Black</td>
<td>11 18</td>
<td>9 30</td>
<td>2 7</td>
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<tr>
<td>Male-Sex-Male</td>
<td>49 82</td>
<td>23 77</td>
<td>26 87</td>
</tr>
<tr>
<td>Heterosexual</td>
<td>8 13</td>
<td>4 13</td>
<td>4 13</td>
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<tr>
<td>Intravenous drug use</td>
<td>3 5</td>
<td>2 7</td>
<td>1 3</td>
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<tr>
<td>Employed</td>
<td>42 70</td>
<td>19 63</td>
<td>23 77</td>
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<tr>
<td>College or degree</td>
<td>38 63</td>
<td>19 63</td>
<td>19 63</td>
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<tr>
<td>Income &lt;$20,000/year</td>
<td>30 50</td>
<td>13 43</td>
<td>17 57</td>
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<tr>
<td>Any antiretrovirals</td>
<td>47 78</td>
<td>25 83</td>
<td>22 73</td>
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<tr>
<td>Protease inhibitors</td>
<td>8 13</td>
<td>4 13</td>
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<tr>
<td>Antidepressants</td>
<td>12 20</td>
<td>5 17</td>
<td>7 23</td>
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<tr>
<td>Anti-anxiety agents</td>
<td>9 15</td>
<td>3 10</td>
<td>6 20</td>
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<tr>
<td>Tobacco</td>
<td>29 48</td>
<td>13 43</td>
<td>16 53</td>
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<tr>
<td>Alcohol</td>
<td>38 63</td>
<td>22 73</td>
<td>16 53</td>
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<tr>
<td>Marijuana</td>
<td>9 15</td>
<td>6 20</td>
<td>3 10</td>
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<tr>
<td>Other illicit drugs</td>
<td>6 10</td>
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<th>Sample</th>
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<td>(n = 60)</td>
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<tr>
<td>M SD</td>
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<tr>
<td>Age (years)</td>
<td>36.0 7</td>
<td>36.6 6</td>
<td>35.4 7</td>
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<tr>
<td>Mean years HIV-positive</td>
<td>4.3 3</td>
<td>4.0 3</td>
<td>4.6 3</td>
</tr>
<tr>
<td>Mean CD4/mm(^3)</td>
<td>347 87</td>
<td>328 69</td>
<td>365 99</td>
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<tr>
<td>Social support</td>
<td>Number</td>
<td>4.57 3.45</td>
<td>3.84 1.61</td>
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<td></td>
<td>Satisfaction</td>
<td>4.50 1.45</td>
<td>4.24 1.66</td>
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<tr>
<td>Perceived stress</td>
<td>6.07 3.51</td>
<td>6.03 3.73</td>
<td>6.10 3.34</td>
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Table 3. Baseline Depressive Symptoms/Mood State Scores

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<tr>
<td>M SD</td>
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<tr>
<td>Center for Epidemiological Studies–Depression Scale</td>
<td>Range</td>
<td>0 to 45</td>
<td>0 to 45</td>
</tr>
<tr>
<td>Mean</td>
<td>13.2 ± 11.2</td>
<td>12.3 ± 11.8</td>
<td>14.1 ± 10.7</td>
</tr>
<tr>
<td>Score 0-14</td>
<td>39 (65%)</td>
<td>22 (73%)</td>
<td>17 (57%)</td>
</tr>
<tr>
<td>Score 16-60</td>
<td>21 (35%)</td>
<td>8 (27%)</td>
<td>13 (43%)</td>
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<tr>
<td>Beck Depression Inventory</td>
<td>Range</td>
<td>–14 to 107.0</td>
<td>–14 to 107.0</td>
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<tr>
<td>Mean</td>
<td>32.8 ± 35.9</td>
<td>34.0 ± 39.3</td>
<td>31.5 ± 32.7</td>
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<tr>
<td>Mean depression</td>
<td>10.9 ± 10.2</td>
<td>10.9 ± 11.8</td>
<td>10.9 ± 8.5</td>
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Psychological Outcomes

Symptom improvement was noted in the exercise group on both indices. Group means and ANCOVA results for dependent measures are reported in Table 5. As compared to study controls, there was significant symptom improvement using the CES-D \( (p = .03) \) and a trend to symptom improvement on the BDI \( (p = .06) \). As a group, exercisers also showed significant \( (p = .01) \) improvements on overall POMS scores and on the depression/dejection subscale \( (p = .05) \).

At both administrations, mean CES-D and BDI scores were highly correlated \( (r = .71, p = .05) \). Pearson product-moment correlations among mean CES-D, BDI, and scores for the sample are shown in Table 1.

Discussion and Implications for Research and Practice

This is thought to be the first report on the effects of aerobic exercise training for depressive symptom management in HIV-infected adults. To overcome limitations of previous studies, we controlled for HIV disease stage and used a randomized design and a supervised exercise intervention based on ACSM guidelines (ACSM, 2000). We also examined concomitant medications and a number of other potentially confounding or explanatory variables.

Only 20% to 35% of participants reported significant levels of depressive symptoms at study entry. Participants who completed the 12-week aerobic exercise program reported improvements in depressive symptoms and depressed mood as compared to a control group that maintained usual activities. Significant improvements were detected on the less somatic depressive symptom index (CES-D) and on the POMS depression subscale. These findings are consistent with the improved mood previously observed in HIV-positive male exercisers (LaPerriere et al., 1990, 1991) and add to the overall body of research linking aerobic exercise and improved mood. Greater improvement on the CES-D scale may be expected because the BDI is generally used in clinical treatment trials as opposed to cohort studies, in which the CES-D is intended as the first-stage screen in a two-step diagnostic process. Limited change on the BDI may also reflect scale inadequacies in this population (Drebing et al., 1994), low observed power, or both.

The numbers of women and Blacks in this study were modest, and randomization did not yield racially balanced treatment groups. Although our participant retention compared favorably with rates in other exercise studies enrolling HIV-infected participants (LaPerriere et al., 1991; MacArthur et al., 1993; Stringer et al., 1998), the disproportionate loss of 40% of the exercise participants limits study findings. Despite significant retention efforts, few Black men...
and no Black women completed the randomized exercise intervention. Individuals who were lost from the study were often among the working poor and reported abrupt changes in employment, unreliable transportation, and increased family responsibilities as reasons for premature study discontinuation. Most exercisers who completed the study were Caucasian men who reported homosexual or bisexual HIV risk factors, and all had CD4 cell counts ranging from 200 to 500/mm³. Researchers should budget for personnel and services that support participant retention in future exercise studies. Transportation, child care, and other services may be needed to retain less economically advantaged participants.

Although it would have been ideal to exclude persons taking antidepressants, only persons on stable drug regimens were enrolled in this study. The use of randomization did balance groups on antidepressant use and should have also controlled for disparate life events, depressive symptoms that may have spontaneously remitted, and differences in concurrent psychotherapy. Because social reinforcement may ameliorate depression, the addition of an attention-only control group may have helped us to examine the influence of social interactions. However, it is worth noting that this study’s exercise intervention did not use a group format, as was the case in LaPerriere and colleagues’ (1991) trial. Moreover, in this sample, exercisers did not differ significantly from control participants on perceived social support. Although exercisers had personal supervision during each session, the exercise facility was similar to the “real-life” setting of a health club or gym. Some sessions were very crowded, but at other times, exercise participants worked out individually. Although this and all studies of exercise must necessarily use convenience samples, some may contend that exercise participants were more motivated to perform because they were research participants. Some participants may have been motivated to continue in the exercise program longer than they might have if they had not been involved in a research study.

Findings of psychological benefit should also be interpreted cautiously because the study attracted few participants with high levels of depressive symptoms. Because 65% to 80% of participants had normal depressive symptom scores at baseline, it is difficult to evaluate the clinical relevance of these findings. Few exercise studies have reported pretest BDI and posttest BDI data; however, the magnitude of CES-D symptom reduction we observed in this study is comparable to that observed by Chesney, Folkman, and Chambers (1996) following a coping effectiveness training program. Moreover, any symptom improvement is desirable as even low symptom burden represents distress and suffering. Preventing or reducing depressive symptom burden over the lengthening course of chronic HIV infection may be very important for adherence and quality of life.

As depressive symptom measures, both self-report measures worked well, and scores were highly correlated providing evidence of convergent validity ($r = .71$). The finding that the CES-D and BDI have convergent validity should help readers better integrate the findings of prior studies that used one of these

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<th>Table 5. Group Means and Analysis of Covariance</th>
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<tr>
<td>Center for Epidemiological Studies–Depression Scale</td>
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<td>$M \pm SD$</td>
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<tr>
<td>Beck Depression Inventory</td>
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<td>$M \pm SD$</td>
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<tr>
<td>Profile of Mood State</td>
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<tr>
<td>Total ($M \pm SD$)</td>
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<td>Depression</td>
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NOTE: Significance indicated with an asterisk.
Symptom measures. These study findings also provide preliminary support for using the POMS depression subscale as a measure of depressed mood in HIV-infected persons.

Symptom management is an essential but often neglected component of HIV care. Because persons living with HIV infection often experience depressive symptoms over the course of their chronic HIV illness, these symptoms warrant systematic study to determine the best management strategies. This study provides preliminary evidence that a program of moderately intense aerobic exercise might be an effective approach to preventing or reducing prevalent symptoms of depression in persons with HIV infection. Additional research is needed to determine whether exercise can benefit HIV-infected persons with significantly higher levels of depressive symptoms. Future researchers should also consider including a social attention control group (in addition to a no-treatment control group).

The differential loss of participants from the exercise treatment group reinforces the general finding that exercise adherence is very difficult for many people. In general, a 50% drop-out rate within 6 months of starting a physician-prescribed or self-selected supervised exercise program is common (Dishman, 1987). Because of the considerable personal effort required for exercise regimen adherence, it is important for researchers to determine the optimal frequency, intensity, and duration for promoting health in this population. By examining the relationships among heart rates during exercise training and exercise attendance, researchers may be able to more completely evaluate possible mediators of improved psychological outcomes.

A growing literature suggests that regular exercise is safe and does not significantly change CD4 cell counts or HIV-RNA copies. Therefore, nurse clinicians can recommend habitual exercise for their HIV-infected patients after a health appraisal as is suggested for all persons before beginning an exercise program (ACSM, 2000). Our study enjoyed strong community interest, but our trainers were impressed at how excellent recruitment and retention rates waned dramatically after the introduction of more effective antiretroviral drug cocktails. Perhaps more recent concerns about HIV-related fat redistribution, metabolic changes, and potential cardiac risks (Carr et al., 1998; Henry, Melroe, Huebsch, Kopaczewski, & Simpson, 1998) will lead to renewed enthusiasm for exercise training among some persons on anti-HIV drug regimens. Nurses may find the current HIV treatment environment may present excellent opportunities to encourage health-promoting behaviors that include regular physical activity.

Acknowledgments

This research was funded by the National Institutes of Health, National Institute of Nursing Research (NR 03974), the National Institute of Allergy and Infectious Diseases (Adult AIDS Clinical Trials Group, A125924), and The Ohio State University College of Nursing. The authors gratefully acknowledge the efforts of the study participants and thank Michael McDonald, Dylan Wessman, Jeremy Johnson, the ACTU staff, and Dr. Jennie Nickel for their important contributions. In remembrance we also acknowledge Dr. Robert J. Fass for his encouragement and thoughtful manuscript reviews.

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