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Solitary Aerobic Exercise as a Treatment of Unipolar Depressive Disorders in Women

Lisa Ann Romano-Neal

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SOLITARY AEROBIC EXERCISE AS A TREATMENT OF UNIPOLAR DEPRESSIVE DISORDERS IN WOMEN

Lisa Ann Romano-Neal, M.A.
Western Michigan University, 1990

The effects of solitary aerobic exercise on depressive symptoms were tested on four women diagnosed with unipolar depressive disorders. A multiple baseline design was employed. The subjects individually participated in uniform one hour aerobic workouts three times a week for five to eight weeks. Heart rate measures were monitored through the utilization of the physical working capacity test with the Monark 818E Professional Ergometer. Predicted volume oxygen uptake (VO2 max) measures at post-treatment did not increase in two of the four subjects when compared to pre-treatment VO2 max measures. The mean percentage of depressed adjectives endorsed showed minimal reductions on the Depression Adjective Checklist (DACL, Lubin, 1967) for all four subjects. This reduction in depressed adjectives endorsed occurred regardless of whether an improvement in cardiorespiratory fitness was observed. This study indicates that exercise-induced antidepressant effects are not restricted to improvements in cardiorespiratory fitness.
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Lisa Ann Romano-Neal
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CHAPTER I

INTRODUCTION

Statement of the Problem

Epidemiological research in psychiatric disorders consistently concludes that affective disorders are one of the more highly prevalent disorders. According to an epidemiological study completed by Boyd and Weissman (1981), it was determined that the point prevalence (proportion of the population that has the disorder being studied at a given point in time) for unipolar depression is 3.2 per 100 males and 4.0 per 100 females. This statistic not only emphasizes the prevalence of depression but the preponderance of females exhibiting depressive symptoms.

Because the lifetime risk of nonbipolar depression has been projected at 20 to 26% for women, it would be cost-effective to develop a range of treatment and prevention programs aimed at this population (Boyd & Weissman, 1981). Currently, the treatment options include drug therapy, psychotherapy, and electroconvulsive therapy. While these treatments have advantages for the individual exhibiting symptoms at the severe end of the depressive spectrum, drug therapies and electroconvulsive therapy are less suitable for individuals exhibiting moderate depressive symptoms. Antidepressant medications often are accompanied by unpleasant side-effects, thus creating problems of compliance. The most effective forms of psychotherapy require a skillfully trained therapist. This limits the availability and cost-effectiveness of services.
Because of the limitations of the prevailing therapies, it is advantageous to research effective, low-cost strategies with minimal side-effects which can be used alone or in conjunction with other methods. Since exercise therapy fulfills the above criteria, it is receiving more attention by both the lay and professional communities.

In response to the enthusiasm of these communities, researchers have begun to empirically investigate the purported relationship between physical fitness training and mental health. Unfortunately, earlier research was plagued with methodological flaws, limiting the inferences that could be drawn. Within the last ten years, as a result of the diagnosis of depression becoming more sophisticated, experimental designs being employed, and the use of objective indices of fitness, better quality research has been conducted (Simons, Epstein, McGowan, & Kupfer, 1985).

Review of the Literature

The following studies present a strong argument for exercise-induced antidepressant effects in individuals with depressive symptoms of clinical proportions. Doyne, Chambless, and Beutler (1983) used a multiple baseline design across subjects to assess the effect of exercise in four women who met the criteria for major depression using Research Diagnostic Criteria (Spitzer, Endicott, & Robins, 1978). An attention placebo-subliminal assertiveness audiocassette tape was the comparison. Treatment consisted of six weeks of four, 30-minute sessions weekly on a bicycle ergometer. Results on the Depressive Adjective Checklist (Lubin, 1967) indicated substantial exercise-induced antidepressant effects. Improvement in physical conditioning was also observed on the treadmill as evidenced by the increase in the amount of time subjects spent on the treadmill and lower exercise heart rate.

The efficacy of exercise therapy in comparison with other therapies has also been investigated. Klein et al. (1985) compared exercise (running), noncultic relaxation-
mediation therapy, and group therapy with 60 randomly assigned subjects for 12 weeks. Subjects met Research Diagnostic Criteria for major and minor depression, in addition to having scores greater than or equal to the 65th percentile on the Symptom Checklist ([SCL], Derogatis, Lipman, & Covi, 1973). At termination of treatment, all three groups showed significant within group difference but no significant between group differences. However, at the nine month follow-up the subjects in the exercise group and in the relaxation group showed further gains resulting in significant differences between these groups and the psychotherapy group. The lack of a control group and powerful comparison treatments to exercise, in addition to no physiological assessment of fitness gains in the exercise group are factors which call into question the validity of these results.

In a study conducted by Martinsen (1987), 49 male and female hospitalized patients ranging in age from 17 to 60 years were randomly assigned to one of two groups, individual and occupational therapy and individual and occupational therapy and exercise training. Within these two groups, 14 patients in the control group and 9 in the training group received tricyclic antidepressant medication. Exercise training consisted of one hour of aerobic activity three times a week for six to nine weeks. The training group showed significantly greater mean reduction scores on the Beck Depression Inventory ([BDI], Beck, Ward, Mendelson, Mock, & Erbaugh, 1961) when compared to the control group. At post-treatment, improved physical conditioning was determined in the training group through the utilization of tests involving the bicycle ergometer.

McCann and Holmes (1984) examined the effects of aerobic exercise, relaxation training, and a no-treatment condition in a sample of 43 college women having a score of 11 or above on the Beck Depression Inventory. Exercise treatment consisted of an aerobics class which met one hour twice a week for a ten week period. Subjects in
the exercise group were also instructed to exercise outside of class in order to achieve an average of 30 aerobic points per week. The test of aerobic capacity consisted of a 12 minute walk/run test which at post-treatment evidenced greater improvements in aerobic capacity for the subjects in the exercise condition. The findings of this study clearly indicated significant improvement in depression scores for the exercise group when compared to the relaxation and the control group. The lack of a formal diagnosis of depression is considered a drawback to the results of this study.

As more studies substantiate the antidepressant effects of exercise, the type of exercise (aerobic vs. anaerobic) which mediates these effects requires empirical investigation. The majority of research conducted has studied the effects of aerobic exercise on depressed mood (Martinsen, 1987). The question of whether or not aerobic exercise is required to achieve these effects has also been examined.

Doyne et al. (1987) randomly assigned 40 women screened on the Research Diagnostic Criteria for major or minor depressive disorder to either an aerobic group (running), an anaerobic group (weight-lifting), or a wait-list control group for eight weeks. Scores on the Beck Depression Inventory, Depression Adjective Checklist, and the Hamilton Rating Scale (Hamilton, 1960) were significantly reduced for both of the exercise conditions but not for the wait-list control condition at the end of treatment. Fitness testing conducted at the termination of treatment indicated no difference in physical fitness between groups. This finding is particularly noteworthy considering that a decrease in depression scores for both the anaerobic and aerobic conditions occurred in the absence of a fitness change for either condition. Since no aerobic effects were assessed, it is questionable whether anaerobic and aerobic exercise were actually compared in this study.

In a similar study, 99 patients meeting the DSM-III-R (American Psychiatric Association, 1987) criteria for major depressive disorder, dysthymic disorder, or
depressive disorder not otherwise specified were randomly assigned to an anaerobic (muscular strength, flexibility, and relaxation exercises) and aerobic (brisk walks/jogging) condition (Martinsen, Hoffart, & Solberg, 1989). Both groups exercised for one hour three times a week for eight weeks. In both groups, depression scores on the Montgomery and Asberg Depression Rating Scale ([MADRS], Montgomery & Asberg, 1979) and the Beck Depression Inventory (BDI) were significantly reduced; thus, there were no significant between-group differences. A significant increase in VO2 Max was found among subjects in the aerobic group but not in the anaerobic group. The only significant flaw in this study was the lack of a control condition. The questions of what type (anaerobic vs. aerobic), and at what range (frequency, duration, and intensity) does exercise produce the greatest psychological benefit require further analysis.

Psychosocial factors are another mechanism purported to mediate the psychological benefits of exercise (Hughes, 1984). The observed effects of exercise could be due to regular social contact with other exercisers and individuals monitoring treatment. Positive and rewarding social contact might occur as a result of the exerciser performing an activity reinforced by the exercise instructors.

Prior studies with favorable outcomes included socialization in their exercise. Klein et al. (1985) and Martinsen et al. (1989) had subjects exercise in small groups under the supervision of an exercise instructor. In Doyne et al. (1987) subjects exercised individually while in the presence of monitors who took frequent pulse checks. Doyne et al. (1983) and McCann and Holmes (1984) confounded treatment effects by allowing the exercise subjects to have frequent contact and supervision, unlike in the comparison treatment.
Purpose of the Present Study

The present study was based on Doyne's et al. study (1983) which evaluated the antidepressant effects of systematic aerobic exercise on four clinically depressed women using a multiple baseline design. Efforts in the present study improved on previous research by (a) employing standardized instrumentation to accurately diagnose and obtain a severity rating of depression, (b) qualifying the exercise by having each subject perform a uniform aerobic activity three times a week for 51 minutes while increasing the training heart zone at predetermined weekly intervals, (c) employing an objective measure of fitness change, and (d) controlling for psychosocial factors by having subjects exercise individually. The present investigation tested the effects of solitary aerobic exercise on depressive symptoms with four women diagnosed with unipolar depressive disorders. It was expected that participation in the aerobic exercise program would have antidepressant effects.
CHAPTER II

METHOD

Subjects

Sixty-nine women responded to an advertisement for a depression management program placed in newspapers and on bulletin boards throughout the local community. Those individuals responding to the advertisement were screened over the phone using the following criteria: (a) nonpregnant females, (b) 18 to 45 years of age, (c) not currently receiving pharmacological treatment for depression, (d) not currently engaging in aerobic exercise more than once a week, and (e) no history of abnormal electrocardiogram, symptoms or problems related to cardiovascular disease.

Of the 69 callers, nine women reported being on antidepressant medication, five reported exercising 3 times a week or more, and thirty-five women refused to participate in the second level of assessment for a variety of reasons.

Twenty women, who met the above criteria, agreed to participate in a second level of assessment to further evaluate their eligibility for this study. The inclusion criteria included: (a) a score of 50 or more on the Zung Depression Scale (Zung, 1965), (b) a score of 5 or more on the Beck Depression Inventory (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961), (c) a score of 11 or more on the Depression Adjective Checklist (Lubin, 1967), (d) a diagnosis of a depressive disorder based on the information obtained in the Diagnostic Interview Schedule: Version III Revised (Robins, Helzer, Cottler, & Goldring, 1989) and DSM-III-R (American Psychiatric Association, 1987) criteria, (e) a maximum score of 26 on the Scale for Suicide
Ideation (Beck, Kovacs, & Weissman, 1979), (f) a maximum score of 22 on the Cardiovascular Risk Questionnaire (Kalamazoo: Western Michigan University, Zest for Life), (g) a physician's statement and accompanying signature on the Medical Clearance Form verifying that the patient had no physical limitations prohibiting engagement in aerobic exercise (Golding, Myers, & Sinning, 1989), and (h) through the use of fitness testing, no signs of physical contraindications to exercise. These criteria are also outlined in Appendix A.

Four of the twenty women evaluated at the second phase of screening did not meet the inclusion criteria. Upon further explanation of the study, six of the twenty women decided not to participate as a result of the time commitment required of the study. Subjects meeting criteria for psychotic and bipolar disorders, or reporting recent suicidal attempts or current suicidal intent were excluded from the study and referred to the appropriate mental health services. One woman began baseline but was removed from the study and referred to inpatient mental health services after reporting suicidal intent.

Nine women began treatment. Five out of the nine women dropped out of the study. One woman developed a physical condition that required immediate surgery. For another woman the exercise sessions were too intense when coupled with a preexisting extracurricular activity. Another young woman of college age decided to quit school and move back home with her parents, and, finally, two women dropped out within the first two to four weeks of treatment due to dissatisfaction with the aerobic activity.

The four women included in this study achieved a severity rating of moderate depression or above on at least two of the three psychological instruments assessing depression. All four women presented primary symptoms of depression and met the DSM-III-R (American Psychiatric Association, 1987) criteria for one of the following
depressive disorders: major depression, dysthymic disorder, or depressive disorder not otherwise specified (NOS). Subject 2 also met DSM-III-R criteria for a generalized anxiety disorder on Axis I. All four subjects denied engaging in regular aerobic exercise. The subjects ranged in age from 22 to 43.

Setting

The initial psychological assessment, exercise sessions and the physiological assessments were conducted individually in the Clinical Research Laboratory in Wood Hall of Western Michigan University, Kalamazoo.

Apparatus

A subject's level of physical fitness was determined by using a Monark 818E Professional Ergometer. Heart rate and blood measures were provided by the SD-700-A Automated Blood Pressure and Pulse Rate Monitor. The uniform, low-impact aerobic exercises were viewed on a Sanyo Beta Videocassette recorder 4030 and a SR100 series color television using the videocassette tape, Richard Simmon's Sweatin' to the Oldies 2 (Simmons & Shipley, 1990).

Physiological Measures

The estimation of maximum oxygen uptake (the maximum amount of oxygen that can be transported to the body tissues from the lungs) was determined through the physical working capacity test as developed by Sjostrand (1947) and the maximal oxygen uptake tests as developed by Astrand and Rhyming (1954) which are outlined in detail in the Y's way to Physical Fitness (1989). Each subject's computed estimated VO2 max was compared to normative data tabled in the Y's Way to Physical Fitness (Golding et al., 1989) to evaluate cardiorespiratory fitness. An improvement
in cardiorespiratory fitness was determined by increases of 5% or more in VO2 max, a higher percentile ranking, and an improved fitness rating at post-treatment.

Resulting diastolic and systolic blood pressures were taken prior to fitness testing to rule out potential contraindicators to the fitness testing procedure.

During exercise training, subjects were given access to an automated heart rate monitor and at set points during the aerobic workout, recorded heart rate measures. These measures served as a guide to the subject and the experimenter that the subjects was exercising in the targeted heart rate zone. The measure of predicted maximum heart rate (220 bpm minus age) was computed at various percentages to determine training heart-rate zones throughout treatment (Golding et al., 1989).

Psychological Measures

The Depression Adjective Checklist ([DACL], Lubin, 1967) served as a daily measure of self-reported changes in mood fluctuations throughout baseline and treatment (Lubin, 1967). The Depression Adjective Checklist consists of a set of seven forms, each containing negative and positive adjectives. Split-half reliabilities for the DACL have been determined at .89 to .92 for patients (Lubin, 1967). The Beck Depression Inventory (BDI) and the Zung Depression Scale (SDS) measured the before and after treatment changes in depressive symptoms (Beck et al., 1961; Zung, 1965). The Beck Depression Inventory is a self-report instrument consisting of a series of 21 ordered statements covering all the major signs of depression. Beck reports a .93 Spearman-Brown corrected split-half reliability of the inventory (Beck, 1972). The Zung Depression Scale is a 20-item psychiatric instrument that operationally defines depression according to somatic, psychologic, psychomotor, and mood symptoms (Zung, 1965).
Procedure

Subjects were screened over the telephone as they responded to the advertisements. Those subjects meeting the initial requirements and showing interest in the study were asked to come to Western Michigan University, Wood Hall, Clinical Research Laboratory to meet with the experimenter and complete the second assessment phase as outlined in Appendix A. An informal consent form allowing the psychological and physiological tests to be administered and a clinical interview to be conducted was administered, reviewed, and signed (Appendix B).

Each subject was informed of the $60.00 deposit that was mandatory for participation in the study and was collected at fitness testing. For each scheduled session in which the subject did not attend and the experimenter was not previously notified, a $5.00 charge was deducted from the $60.00. If a subject failed to attend six scheduled sessions, she was released from the study with $30.00. Subjects were also informed of a $20.60 bonus that was contingent on exercising three times a week for eight weeks. Thus, a subject would receive $80.60 if she completed the study in its entirety.

If a subject met the inclusion criteria and agreed to participate in the aerobic exercise program, an informed consent (Appendix C) explaining the conditions of the study was signed. A release of information (Appendix D) was also signed allowing the experimenter to contact a subject's physician or Western Michigan University's Sindecuse Health Center to obtain a physician's signature on the Medical Clearance Form (Golding et al., 1989). Subjects were given a set of Depression Adjective Checklists and were asked to complete one checklist before retiring to bed each night.

As soon as a subject obtained medical clearance, a second appointment was schedule for fitness testing and subjects were informed of pre-test instructions to follow for the twenty-four hours prior to fitness testing.
Prior to the start of the fitness testing, subjects were informed of the procedure and the physiological responses to monitor during the test. Fitness testing consisted of having each subject pedal on a stationery bicycle to gradually increasing workloads while the researcher monitored and recorded heart rate through the use of a pulse rate monitor attached to the subject's finger.

Exercise treatment commenced as soon as stability among a subject's data points could be observed and in order to proceed with design specifications. Subjects were assigned a code number so the the subject's privacy and confidentiality of information were assured.

Each subject was given instructions on how to take heart rate manually or with the automated heart rate monitor. They could use either method. Subjects were given notebooks and instructed to record their exercise heart rate at intervals signaled by the exercise tape.

As recommended by the American College of Sports Medicine, subjects were encouraged to schedule three aerobic workouts per week (Medicine and Science in Sports, 1978). The aerobic activity chosen met within the guidelines suggested by the American College of Sports Medicine for participants of initial fitness levels of poor to average (American College of Sports Medicine, 1979). The aerobic activity was of low intensity conducted over a longer period of time involving the use of large muscle groups. Each exercise session consisted of a standard aerobic format: six minute warm-up, thirty-five minute aerobic workout, and a ten minute cool-down. All subjects began exercising with a training heart rate of 70% of maximum heart rate. The intensity of training was gradually increased to 75% of maximum heart rate during the fifth week of exercise and 80% of maximum heart rate at the seventh week of exercise. Subjects were instructed on strategies for increasing and lowering heart rate in order to remain in the training heart rate zone while exercising. The
experimenter provided feedback to the subject if the recorded exercise heart rate was incongruent with the targeted heart rate zone. Subjects became skilled in judging the intensity of their workout after one to two weeks. After this brief period, subjects' recordings of exercise heart rate showed little to no discrepancy with the targeted heart rate zone.

Subjects exercised individually in the Clinical Research Laboratory. The experimenter had limited contact with the subject before and after each exercise session in order to assess attendance and to schedule future sessions.

A subject was scheduled for a fitness test based on an equivalent protocol after the subject stopped exercising. Subjects 1 and 2 were asked to complete a fitness test at six weeks in addition to an eight week fitness test in order that fitness changes could be compared among the subjects after equivalent weeks of exercise. Subjects continued to fill out Depression Adjective Checklists for an additional two to four weeks after treatment. The $60.00 deposit and bonus were disseminated according to each subject's level of compliance.

Those individuals that did not meet the requirements of the study or failed to complete the study were referred to other mental health agencies.

Experimental Design

A multiple baseline across subjects design was implemented to test the effects of solitary aerobic exercise on depressive symptoms. The amount of time subjects spent in baseline varied depending on the stability of a subject's data points and in order that the onset of treatment could be staggered across subjects. Subjects continued to complete daily measures of depression for two to four weeks after treatment.
CHAPTER III

RESULTS

Physiological and Exercise Treatment Measures

VO2 max levels at pre and post-treatment are summarized in Figure 1. Overall, subjects 2 and 3 showed an increase in cardiorespiratory fitness at post-treatment while subjects 1 and 4 did not. Subjects 1 and 2 followed the prescribed exercise regimen whereas subjects 3 and 4 did not. Individual results are described in detail below.

Subject 1's pre-treatment VO2 max was computed at 37.74 which fell into the range of above average physical fitness and between the 70th and 75th percentile when compared to other females in the same age group. After six weeks of exercise, VO2 max was measured at 43, placing Subject 1 between the 80th and 85th percentile with an improved fitness rating of good suggesting an improvement in cardiorespiratory efficiency. The post-treatment VO2 max of 37 after eight weeks of exercise treatment, placed this subject in the 70th percentile and again at the above average range of cardiorespiratory fitness. The post-treatment, eight week measure approximates the measure of VO2 max computed at pre-treatment suggesting a discrepancy between estimated measures at six and eight weeks. The 2% decrease in VO2 max between pre and post-treatment, 8 weeks was unexpected considering Subject 1 averaged 3 exercise sessions a week over eight weeks.

Subject 2's estimated pre-treatment VO2 max was 32.43, placing this subject between the 50th and 55th percentile and in the average range of cardiorespiratory
Figure 1. Measure of VO₂ Max (ml/kg) for Each Subject.
fitness when compared to other females in the same age group. After six weeks of exercise, VO2 max was computed at 35.5, placing Subject 2 between the 60th and 65th percentile and in the above average range of cardiorespiratory fitness. After eight weeks of exercise, the post-treatment VO2 max measured 39.25, placing this subject between the 75th and the 80th percentile and with an improved fitness rating of good, suggesting a steady improvement in cardiorespiratory fitness throughout treatment. This steady increase in VO2 max of 21% throughout treatment was expected as subject 2 exercised regularly averaging three exercise sessions a week over eight weeks.

Subject 3's pre-treatment VO2 max was 17.9 which constituted a physical fitness ranking at the 0 percentile and a fitness rating of very poor when compared to other females in the same age group. After six weeks of exercise, Subject 3's post-treatment VO2 max was 23.3 denoting an increase in rank to the 15th percentile and an improved fitness rating of poor. The 30% increase in VO2 max from pre to post-treatment was surprising considering Subject 3 exercised 18 times over an 11-week period averaging less than twice a week on four of the eleven weeks.

Subject 4's VO2 max measure at the onset of treatment was 28.23 ranking the subject between the 10th and 15th percentile and with an initial fitness rating of very poor to poor when compared to other females of the same age group. After five weeks of exercise, the subject's post-treatment VO2 max measure was 22.52 placing her near the 5th percentile with a fitness rating of very poor, thus indicating a 20% reduction in VO2 max since the onset of treatment. These results were not surprising given that Subject 4 exercised only 15 times in a span of nine weeks with all 15 exercise sessions occurring over a five week period.
Post-Treatment Exercise Measures

Subject 1 reportedly joined an aerobics class after treatment and recorded the days she attended the class. Subject 1 averaged two exercise workouts a week for the four weeks during which data were collected following treatment. Subject 2 recorded days exercised for three and a half weeks following treatment. Subject 2 averaged two workouts a week. Thus, subjects 1 and 2 averaged one less workout a week during post-treatment than during treatment. Subject 3 anecdotally reported exercising five times in the three and a half weeks during which data were collected following treatment averaging less than two workouts a week. Subject's 3's post-treatment exercise measures were comparable to her exercise treatment measures. Subject 4 anecdotally reported exercising only intermittently after treatment ended suggesting a similar pattern of exercise as during treatment.

Psychological Measures

Depression Adjectives Checklist

The Depression Adjective Checklist (DACL, Lubin, 1967) was scored by determining the percent of depressed adjectives endorsed daily and the percent of positive adjectives endorsed daily. Overall, all four subjects showed minimal reductions in the percentage of depressed adjectives endorsed when comparing the baseline and treatment mean scores. Subjects 1, 2, and 4 also showed minimal increases in the percentage of positive adjectives endorsed from baseline to treatment.

To determine whether the results of the DACL were clinically significant, the DACL was scored according to its intended usage by totaling the number of depressed adjectives checked and the number of positive adjectives not checked to determine a combined adjective score per checklist. The four DACL cut-off scores indicating
depression are as follows: (1) 8 to 10 is average, (2) 11 to 12 is mild, (3) 13 to 14 is serious, and (4) 15 and above is severe. Subjects 1, 2, and 4's improved severity ratings were of clinical significance.

Subject 1's baseline mean score for the percentage of depressed adjectives endorsed on the DACL was 21.50. The treatment mean score was 11.51, indicating approximately a 50% reduction in depressed adjectives for Subject 1. Subject 1 continued to exercise after treatment which was reflected by continued treatment effects and a post-treatment mean score of 5.96. Increases in the percentage of positive adjectives endorsed on the DACL were minimal as evidenced by a mean score of 4.50, a treatment mean score of 7.83 and a post-treatment mean score of 10.82. The first data are presented in Figure 2.

Subject 1's mean combined adjective score of 15 during baseline gave her a severity rating of severe depression. This mean score was reduced to 12.48 during treatment which resulted in an improved severity rating of mild depression, thus indicating some alleviation of depressed mood.

A reduction in depressed adjectives endorsed on the DACL was clearly evident through visual inspection for Subject 2. Subject 2's baseline mean score of 17.78 and treatment mean score of 9.28 suggested an approximate reduction of 50% in the percentage of depressed adjectives endorsed from baseline to treatment. The post-treatment mean score was computed at 4.64. An increase in positive adjectives endorsed on the DACL was minimal with a baseline mean score of 1.47, a treatment mean score of 6.25, and a post-treatment mean score of 9.92. These data are presented in Figure 3.

Subject 2's mean combined adjective score was 14.57 giving her a severity rating of serious depression during baseline. During treatment the mean combined adjective
Figure 2. Percent of Positive and Depressed Adjectives Endorsed for Subject 1.
Figure 3. Percent of Positive and Depressed Adjectives Endorsed for Subject 2.

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score was 12.32 giving Subject 2 a severity rating of mild depression indicating a reduction in symptoms of depressed mood.

A reduction in the depressed adjectives endorsed on the DACL was not easily inspected visually on the graph for Subject 3; however, the computed baseline mean score of 34.20 and the treatment mean score of 24.20 signified a decrease in the depressed adjectives endorsed between baseline and treatment. The post-treatment mean score of 37.91 indicated an increase in self-reported depressed mood after treatment ended. The percentage of positive adjectives endorsed on the DACL noted a baseline mean score of .125 and a treatment mean and post-treatment mean score of 0.00. These scores reflected an absence of positive adjectives endorsed during treatment and after treatment. These scores can be observed in Figure 4.

Subject 3's mean combined adjective score was 18.33 during baseline which constituted a severity rating of severe depression. The mean score during treatment of 16.28 evidenced a comparable severity rating of severe depression showing no change in the intensity of depressed mood.

A notable reduction in depressed adjectives endorsed was observed for Subject 4 when a treatment mean score of 21.05 and a post-treatment mean score of 21.08 was compared with a baseline mean score of 38.40. With respect to positive adjectives endorsed, Subject 4's baseline mean score of 22.31, treatment mean score of 29.31, and post-treatment score of 12.50 indicated a small increase in positive adjectives endorsed from baseline to treatment followed by a marked reduction in positive adjectives endorsed at post-treatment. The percentage of depressed and positive adjectives endorsed on the DACL for Subject 4 can be observed in Figure 5.

Subject 4's mean combined adjective score of 16.84 during baseline gave her a severity rating of severe depression. The mean score of 11.98 during treatment
Figure 4. Percent of Positive and Depressed Adjectives Endorsed for Subject 3.
Figure 5. Percent of Positive and Depressed Adjectives Endorsed for Subject 4.
showed an improved severity rating of mild depression indicating some alleviation of depressed mood.

**Beck Depression Inventory**

Subjects 1 and 4 showed minimal reductions in depression scores on the Beck Depression Inventory ([BDI], Beck et al., 1961) while Subjects 2 and 3 did not. Subjects 1 and 4's reduction in depression scores on the BDI were not clinically significant. Subject 2 evidenced a clinically significant change from moderate to serious severity of depression as a result of the higher score at post-treatment.

Subject 1 showed minimal decreases in the depression scores on the BDI with a pre-treatment score of 39 and a post-treatment score of 33. A minimal decrease in scores on the BDI for Subject 4 was noted with a pre-treatment score of 18 and a post-treatment score of 17. The BDI scores for Subject 2 reflected an increase in self-reported depressive symptoms with a pre-treatment score of 15 and a post-treatment score of 20. The BDI also showed an increase for Subject 3 in depressive symptoms acknowledged after treatment when compared to the before treatment value with pre-treatment score of 23 and a post-treatment score of 33.

**Self-Rating Depression Scale**

There were also minimal reductions in depression scores on the Self-Rating Depression Scale ([SDS], Zung, 1965) for Subjects 1, 2, and 4 but not for Subject 3 who evidenced equivalent pre-treatment and post-treatment scores. Subject 1's reduced depression score at post-treatment indicated a clinically significant change in the severity of depression from severe to moderate depression. Subject 4's change in depression scores from pre to post-treatment was also of clinical significance. An
improved severity rating of moderate depression was concluded at post-treatment compared to a rating of marked depression at pre-treatment. Subject 2’s change in depression scores was not of clinical significance.

A pre-treatment score of 70 and a post-treatment score of 64 was evident for Subject 1. A minimal decrease in SDS scores with a pre-treatment score of 46 and a post-treatment score of 45 was noted for Subject 2. A pre-treatment score of 68 and a post-treatment score of 60 signified a minimal reduction in depression scores on the SDS for Subject 4. The SDS scores for Subject 3 were identical at pre- and post-treatment.
CHAPTER IV

CONCLUSION

Discussion

The results of the present investigation provide evidence that participation in an aerobic exercise program may induce some antidepressant effects, particularly in self-reported depressed mood. Mean scores for the percentage of depressed adjectives endorsed on the Depression Adjective Checklist (DACL, Lubin, 1967) were reduced for all subjects by the end of treatment. Three out of four of the subjects showed changes of clinical significance on the DACL. This reduction in depression scores occurred for subjects self-reporting moderate to marked severity of depression. Consistent with the findings of Doyne et al. (1983), the mean scores for the percent of positive adjectives endorsed on the DACL were slow to appear.

The pre-treatment and post-treatment scores on the Beck Depression Inventory (BDI, Beck et al., 1961) and Self-Rating Depression Scale (SDS, Zung, 1965) were not comparable to the reduction in self-reported depressed mood shown by the DACL. This inconsistency among outcome measures is likely attributed to the varying contents of these instruments. The DACL is a scale that emphasizes mood symptoms. The BDI and the SDS also include cognitive, overt-behavioral, and somatic and interpersonal disturbances that are often associated with a syndrome of depression (Bellack & Hersen, 1988). In addition, because the DACL was the daily measure of mood throughout the study, subjects' results may have been adversely affected by daily exposure to the scale.
A reduction in the mean percentage of depressed adjectives endorsed occurred on the DACL independent of whether there were improvements in cardiorespiratory fitness. This finding is consistent with the results of previous studies. Only two of the four subjects evidenced observable increases of at least 5% in VO2 max at post-treatment when compared to the pre-treatment VO2 max; however, all four subjects endorsed a lower percentage of depressed adjectives during treatment as compared to during baseline.

Even though there were observable increases or decreases in VO2 max, it is unclear whether or not these variations can be attributed to changes in physical fitness. The objective index of fitness change implemented in this study was a submaximal test based on predicted values. This particular test was chosen as it offered several advantages over other fitness testing procedures. It was easy to administer by a non-exercise specialist, offered less chance of aversive consequences than a maximal test, was less dependent on subject motivation, and the fitness measures obtained during a sub-maximal fitness test had been proven to correlate highly with the fitness measures obtained during maximal testing procedures. However, despite its perceived advantages, it has a standard error of estimate of plus and minus 15% (Davies, 1968). When the test error is contrasted against improvements in VO2 max of 5 to 25% which can occur depending on the quality and quantity of training as concluded by the American College of Sports Medicine’s Position Statement on the "Recommended Quantity and Quality of Exercise for Developing and Maintaining Fitness in Healthy Adults" (1979), it then becomes difficult to interpret Subject 2 and 3’s increases in VO2 max as due to training effects.

The American College of Sports Medicine (1979) also concluded that significant reduction in working capacity occurs after two weeks of detraining and that participation of less than two days per week will not show adequate change in VO2
max. Thus, it is not surprising that Subject 4's VO2 max at post-treatment was 20% lower than the initial VO2 max. Detraining effects may have occurred as Subject 4 required an extensive leave of absence from the exercise program for surgery, thus requiring her to function at an unusually low level of activity for four weeks. Despite an inconsistent adherence to the exercise program, it was surprising that Subject 3's VO2 max reflected an increase of 30% when compared to the initial VO2 max. Detraining effects were expected as a result of her level of compliance to the exercise program.

Due to Subject 1 and 2's regular exercise of three times a week for eight weeks, if an increase in post-treatment VO2 max could be attributed to training effects, it would be substantiated for these two subjects. It is probable that Subject 2 evidenced some improvement in cardiorespiratory fitness. Subject 1's VO2 max showed an increase at six weeks but at eight weeks showed no change when compared to the initial VO2 max. The reasons for this discrepancy could possibly be attributed to test error or a lack of a fitness effect due to low intensity training. This subject's estimated initial VO2 max placed her at the above average level of fitness and yet she was subjected to the same intensity of training as the other exercise participants.

While it is difficult to accurately determine from the VO2 measures whether the subjects actually achieved improvements in aerobic capacity, it can be inferred that an aerobic effect is not necessary for participation in exercise to demonstrate mood-altering effects. The physiological theories implying that a fitness effect is required to mediate the psychological benefits of exercise are slowly being proven deficient. There are several theories proposing the process or processes that mediate the psychological benefits of exercise in depression.

Psychosocial factors were given particular consideration when designing the exercise program as a possible mechanism mediating the psychological benefits of
exercise. Subjects exercised alone in order to control for social interaction among exercisers. The experimenter was intermittently present before and after the exercise sessions which possibly provided for an increased frequency of social reinforcement. Since the experimenter attempted to keep these interactions with the subjects brief and focused on scheduling future sessions, it is not likely that the limited social contact that occurred was responsible for reducing the subject's depression.

Cognitive and behavioral processes have also been proposed to mediate the antidepressant effects of exercise. Exercise may provide a series of graded mastery experiences that may enhance self-efficacy, which in turn may influence positive changes in affect (Bandura, 1977). According to Lewinsohn and Hoberman (1982), exercise is an activity that increases the rate of response-contingent positive reinforcement. Improved mood and increased behavioral output occur as a result of changing the contingency schedule to a positive one.

Biochemical hypotheses proposed for mediating the psychological benefits of exercise include increased aminergic synaptic neurotransmission and neuroepinephrine, dopamine and serotonin levels which contribute to an elevated mood; however, the data on this and other theories is largely inconclusive (Howley, 1976; Ransford, 1982).

While it is difficult to pinpoint the processes contributing to the exercise-induced effects in depression, it is just as difficult to motivate depressed individuals to exercise. It is possible that in an attempt to delineate the processes mediating the psychological benefits of exercise, active ingredients promoting exercise compliance were compromised. Martin et al. (1984) found empirical evidence for the importance of social reinforcement, i.e., personalized feedback and praise, and social support factors, i.e., group/social setting for promoting exercise adherence and maintenance. Compliance to the exercise program might have been more successful if the exercise
regimen had been tailored to the individual, i.e., allowing the subject more input in setting fitness goals and increasing the intensity of training according to a subject's readiness. The compliance intervention used in this study, the monetary contract, was not potent enough to have impact on compliance. According to Haynes (1984), the compliance interventions that have been successful for long-term treatment programs have included two or more strategies.

Most inquirers of the depression program refused treatment. The women reported that they were too busy to commit to an exercise program which involved them going to a site three times a week to exercise. A majority of the women reported working outside the home and child care as responsibilities that severely restricted them from taking on yet another activity. Of the four subjects that participated in the exercise program, one woman worked full-time as a school teacher and another woman went to school full-time. Both of these women had older children that could be left at home unattended in addition to a schedule that allowed for some flexibility. The other two women were unemployed at the time of the exercise program. One of these women had a small child that she left in the care of her husband in the early evening, so she could leave home to exercise. These factors suggest that there were some differences between the depressed subjects that were represented in this study and the women who inquired about the study. Thus, one of the prominent differences between the populations might have been the support of the depressed individual's immediate environment in terms of a flexible schedule and accommodating family and friends.

Recommendations

Some possible limitations of this study and suggestions for future research include: (a) use of more sensitive, objective indicators to measure fitness changes; (b)
implementation of a compliance "package" consisting of two or more proven effective strategies; (c) generalization training, i.e., generalizing to new exercises, (response generalization) and new environments (stimulus generalization) to assure exercise maintenance (Martin & Dubbert, 1984).

Endnotes

It seems that exercise can reduce depressed mood. The amount of change that can be expected appears to vary with the individual and doesn't necessarily depend on fitness gains. Exercise appears most suitable for individuals self-reporting depressive symptoms with a severity rating of mild to marked, thus, excluding individuals reporting very severe symptoms of depression. The potential drawbacks of exercise therapy are related to its acceptability and stability; thus, it is unlikely that a depressed individual will maintain an exercise regimen unless exercise has been systematically shaped during a supervised and guided program and becomes an integral part of that individual's lifestyle. Also, exercise therapy has not yet been proven to have long-lasting antidepressant effects, so once regular exercise is discontinued, depressive symptoms may reoccur.
Appendix A

Sample of the Inclusion Criteria for Study
Inclusion Criteria For Study

1. A score of 50 or more on the Zung Depression Scale (Zung, 1965).

2. A score of 5 or more on the Beck Depression Inventory (Beck et al., 1961; Lewinsohn, Munoz, Youngren, & Zeiss, 1986).

3. A score of 11 or more on the Depression Adjective Checklist (Lubin, 1967).


5. A score no greater than 26 on The Scale for Suicidal Ideation (Beck, Kovacs, & Weissman, 1979).

6. A maximum score of 22 points on the Cardiovascular Risk Questionnaire (Kalamazoo: Western Michigan University, Zest for Life), in addition to no more than two high risk levels identified beyond the risk factor of sedentary lifestyle.

7. Medical Clearance Form (Golding, Myers, & Sinning, 1989): A physician's statement and accompany signature verifying that the patient has no physical limitations preventing participation in an aerobic exercise program.

8. Through the use of fitness testing, no signs of physical contraindications to exercise.
Appendix B

Sample of the Informed Consent for Selection Procedures
Informed Consent for Selection Procedures

Program Name: Depression Management Program

Investigators: Lisa Ann Romano-Neal, B. S. & M. Michele Burnette, Ph.D.

I understand that I have been invited to participate in a research study designed to decrease symptoms of depression.

I am aware that my participation in this study is voluntary and that I may withdraw my consent at any time.

I understand that I must meet specific selection requirements in order to participate in the depression program. I authorize that the following psychological and physiological instruments be administered and interpreted:

• The Self-Rating Depression Scale, the Beck Depression Inventory, The Depression Adjective Checklist and the Diagnostic Interview Schedule: instruments designed to measure depressive symptoms.
• The Suicidal Behaviors Questionnaire: an instrument designed to assess the potential for suicidal behaviors.
• The Cardiovascular Risk Questionnaire: a screening instrument designed to obtain general information about a participant's physical condition in addition to estimating a participant's risk for exhibiting heart complications while engaging in aerobic exercise.

The Medical Clearance Form is a form that your physician will need to sign to verify that you do not have any physical limitations preventing you from participating in fitness testing or an aerobic exercise program.

Fitness Testing: The purpose of the fitness testing is to evaluate cardiorespiratory fitness. The cardiorespiratory fitness test involves pedaling on a stationary bicycle to gradually increasing tension levels while your heart rate is monitored by the researcher through the use of an exercise/pulse monitor. At no time will this become too strenuous.

I understand that I am responsible for monitoring my own physiological responses (heavy breathing, perspiring, light-headedness, muscle soreness, joint pain, loss of coordination, and tightness in chest) throughout the fitness testing. If any unusual symptoms should occur, I will stop pedaling and inform the researcher. The reaction of the cardiorespiratory system cannot be predicted with complete accuracy. There is a risk of abnormalities of blood pressure and/or heart rate that might occur during or following exercise.

I also understand that the personal information obtained from the above instrumentation and the structured, clinical interview will be kept confidential. I understand that a code number will be assigned to my name which will be used to identify all information relating to myself. The primary researcher will keep a master list which matches my name to the coded data.

I understand that if I fail to meet the above requirements or follow through with the subject selection process, I will receive a phone call referring me to alternative mental health agencies. In the event that I do not participate, I can request to have the data pertaining to myself destroyed.

I understand that any questions or complaints can be directed to Dr. M. Michele Burnette at 387-4472 or Lisa Ann Romano-Neal at 343-9567.
My signature indicates that I understand the above information and have decided to participate in the selection phase of this study.

______________________________  ______________________
Name                        Date

______________________________  ______________________
Witness                      Date

______________________________  ______________________
Investigator                  Date
Appendix C

Sample of the Informed Consent for Participation in an Aerobic Exercise Program
Program Name: Depression Management Program

Investigators: Lisa Ann Romano-Neal, B.S. & M. Michele Burnette, Ph.D.

I understand that I have been invited to participate in a research study designed to decrease symptoms of depression.

I am aware that my participation in this study is voluntary and that I may withdraw my consent at any time.

I am aware that a $60.00 deposit is mandatory for participation in this study. This deposit will be collected at the initial fitness testing session and will be returned at the final fitness testing if I attend 24 sessions. For each scheduled session in which I did not attend and did not previously notify the experimenter, a $5.00 charge will be deducted from the $60.00. If I accumulate more than five missed sessions in which I did not previously notify the experimenter, I will be released from the study with $30.00. I also understand that if I complete the study in its entirety, I am eligible for a $20.60 bonus. Thus, I would receive $80.60 at the final fitness testing if I complete the depression management program in its entirety.

The aerobic exercise program will involve a baseline period of a couple of weeks. During this baseline period, I will complete the psychological and physiological tests. After the baseline period, the aerobic exercise program will begin and will consist of a 51 minute workout, three times a week for eight weeks. The aerobic exercise program involves exercising alone in the Clinical Research Laboratory in Wood Hall at Western Michigan University to a videocassette tape. The exercise will consist of a warm-up period, low-impact aerobic workout at a predetermined training heart rate, and a cool-down period. The intensity of the workout will be regulated by the targeted training heart and my perceived level of exertion.

I am also aware that I will be trained in and responsible for monitoring my heart rate during the exercise sessions to guard against overexertion. I understand that I am responsible for monitoring my own physiological responses (heavy breathing, perspiring, light-headedness, muscle soreness, joint pain, loss of coordination, tightness in chest, and excessive heart rate) throughout the aerobic exercise program. If any unusual symptoms should occur, I will cease exercising and inform the investigators of the symptoms. I understand that the reaction of the cardiorespiratory system cannot be predicted with complete accuracy. There is a risk of abnormalities of blood pressure and/or heart rate that might occur during or following exercise.

All information obtained during this study will be kept confidential. I understand that a code number will be assigned to my name which will be used to identify all information relating to myself. If at anytime I discontinue participating in this study, I can request to have the data pertaining to myself destroyed.

I understand that any questions or complaints can be directed to Dr. M. Michele Burnette at 387-4472 or Lisa Ann Romano-Neal at 343-9567.
My signature indicates that I have read this form and understand the above information and that my questions regarding the exercise program have been answered to my satisfaction.

My signature also indicates that I have agreed to participate in this study.

_________________________    ______________________
Name                        Date

_________________________    ______________________
Witness                     Date

_________________________    ______________________
Investigator                Date
Appendix D

Sample of Release of Information
Release of Information

I, _________________________________; agree to allow Lisa Ann Romano-Neal of the Department of Psychology at Western Michigan University to obtain information outlined on the attached form from my medical files located in the office of:

___________________________________________ Physician's Name

___________________________________________ Physician's Address

Please complete the attached form and return to:

Lisa Ann Romano-Neal
c/o Dr. M. Michele Burnette
Department of Psychology
Western Michigan University
Kalamazoo, Michigan 49008

_____________________________  ______________________________
Signature of Participant                           Signature of Researcher

_____________________________
Date
Appendix E

Approval Letter From the Human Subjects
Institutional Review Board
Date: February 28, 1990
To: Lisa Ann Romano-Neal
From: Mary Anne Bunda, Chair

This letter will serve as confirmation that your research protocol, "Social Vs. Solitary Exercise in the Treatment of Clinical Depression in Women", has been approved as full by the HSIRB. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the approval application.

You must seek reapproval for any change in this design. You must also seek reapproval if the project extends beyond the termination date.

The Board wishes you success in the pursuit of your research goals.

xc: M. Burnette, Psychology

HSIRB Project Number 89-11-36

Approval Termination February 28, 1991


*Cardiovascular Risk Questionnaire*. Kalamazoo: Western Michigan University, Zest for Life.


