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The effects of a ten-week aerobic fitness program on depression

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THE EFFECTS OF A TEN-WEEK AEROBIC FITNESS PROGRAM ON DEPRESSION

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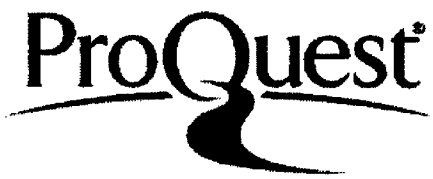

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Chapter I

INTRODUCTION

Throughout the ages, certain segments of society have championed the idea of a holistic view of human nature. Such a view puts forth the concept that to be maximally healthy, one needs to have a healthy mind as well as a healthy body. The mind-body relationship is interdependent and the health of the mind effects the health of the body, and vice-versa. The renowned French essayist Michel de Montaigne (1533-1592) in Book I, Chapter 25, of the Essays (1580), stated,

> "Health and strength are necessary, for the soul will be oppressed if not assisted by the body....I know very well how much mine groans under the disadvantage of a body so tender and delicate that externally leans and presses upon her....Our very exercises and recreations, running, wrestling, music, dancing, hunting, riding, and fencing will prove to be a good part of our study. I would have his outward behavior and mien, and the disposition of his limbs formed at the same time with his mind. It is not a soul, it is not a body, that we are training up; it is a man, and we ought not to divide him into two parts; and as Plato says, we are not to fashion one without the other, but make them draw together like two horses harnessed to a coach. By which saying of his does he not seem to allow more time for and to make more care of, exercises for the body and to believe that the mind in a good proportion does her business at the same time too?....Inure him to heat and cold, to wind and sun, and to danger that he ought to despise. Wean him from all effimacy in clothes and lodging, eating and drinking; accustom him to everything that he may not be a Sir Paris, a carpet-knight, but a sinewy, hardy, and vigorous young man."

John Locke (1632-1704) the great English philosopher in his Some Thoughts on Education in 1693, speaks on the mind-body interaction,

"Keep the body in strength and vigor so that it may be able to obey and execute the orders of the mind....A sound mind in a sound body, is a short but full description of a happy state in this world; he that has these two has little more to wish for; and he that wants either of them will be but little the better for anything else....He whose mind directs but wisely will never take the right way; and he whose body is crazy and feeble will never be able to advance to it."

The holistic view of man's mind and body being unified and inseparable has an intrinsic appeal, and being thusly combined it is natural to assume that they affect one another, albeit as of now we know not to what degree. (Leonard, 1923).

There has been much anecdotal evidence to support the mind-body interaction but until recently good scientific research supporting the holistic view was lacking. Evidence showing that physical substances such as alcohol and certain drugs affect emotional states has been demonstrated. Also, one's thoughts have been shown to affect certain body conditions in psychosomatic illnesses.

The effect of one's physical health in mediating psychological health has long been assumed. Although much anecdotal evidence has been offered, until recently, little systematic scientific research has been carried out. One area of mental health that seems to be particularly malleable by physical fitness is that of depression. Depression is a particularly debilitating affliction affecting most every person at some time in their life. If it could be shown that aerobic physical fitness could be used as an effective treatment for alleviating depression it would be very helpful to mental health professionals everywhere. Does an increase in physical fitness result in a reduction of level of depression? The answer to this question is very important to all those who suffer from continuous or inter-

mittent bouts of depression as well as those concerned with the psychological well being of others. This experiment addresses itself to adding more information to the resolution of this question.

Definition of Terms

Depression. Depression has been defined as an emotional attitude, sometimes definitely pathological, involving a feeling of inadequacy and hopelessness, sometimes overwhelming, accompanied by a general lowering of psycho-physical activity. Depression affects many areas of a person's life, including social interaction, mood, thinking, eating, sleeping, and others. A depressed person's thoughts focus on helplessness, hopelessness, and feelings of low self-worth. One's activity is very restricted and tiresome. Interaction with others is low and stressful to engage in. Sleep may be restless, appetite lost, weight lost, sex drive gone or lessened, and mood swings are very common, with feeling lowest in the morning and highest in the evening (Becker, 1977). A depressed person may experience any or all of these symptoms in varying degrees.

Aerobic Physical Fitness. Aerobic physical fitness is the maximum ability of the body to take in, transport, and use oxygen. It consists mainly of a well-developed delivery system, i.e., heart, lungs, and venous system. Aerobic exercises are those that contribute to the enhancement of this cardiovascular system, and include such activities as running, swimming, cycling, walking, jogging, etc. (Sharkey, 1977).

Depression

Depression is currently the most common psychological illness diagnosed by physicians (Oliver & Simmon, 1984). In a random sample of American adults it was found that about 15 percent suffered from depression (Becker, 1977). Suicide was found to be the third leading cause of death among teenagers (Sudak, Ford, & Rushforth, 1984) and 50 percent of all adults are expected to have a serious bout of depression in their lifetime (Becker, 1977).

The way depression affects a person varies, but there are certain commonologies in symptoms. A depressed person often feels sad or low, thoughts focus on themes of helplessness, hopelessness, and low self-worth. Energy to initiate or participate in activities is low. There is little or no will towards social interaction. Sleep is disturbed, appetite or weight loss is common. Previously enjoyable activities or friends are not enjoyable. Sex drive is lessened and there is often diurnal mood swings, feeling lowest in the morning and highest in the evening (Becker, 1977).

The cause of depression has not been distinctly identified and is often thought to come from a variety of influences. Three theoretical views of the cause of depression are currently popular. They take a biological, behavioral, or cognitive perspective.

The biological theories of depression have two main orientations, a neurological one stating a genetic tendency towards depression or secondly, a biochemical imbalance. The neurological explanations have stated a hereditary proneness to depression based on some type of pyschological disorder, although the disorder has not been found. A number of studies have given evidence in support of bipolar affective illness, i.e., manic depression (Akiskal &

McKinney, 1975; Rainer, 1984).

The most popular biochemical therapy of depression was introduced by Schildkraut (1974), and includes biogenic amines and is referred to as the catecholamine hypothesis. Catecholamines (neural transmitters) in excess was thought to be related to an elevation of mood while a deficiency of catecholamines was associated with depression. Of the amines associated with depression, the catecholamines, norepinephrine, and dopamine, the inoleamine, serotonin, and the quarternary amine, acetycholine were the most important (Baldessarini, 1975). Helping the cause of the catecholamine hypothesis was the alleviation of depression in hospital patients who were given monoamine oxidose (MAO) inhibitor, that has the effect of slowing the breakdown of norepinephrine. In lieu of supporting evidence, the catecholamine hypothesis has had trouble explaining rapid mood shifts of many depressed individuals.

Giving weight to a biological theory of depression is research with the alkaline ion, lithium, which has been shown to be an effective treatment for manic-depression but not for unipolar affective illness. Lithium seems to be involved in electrolyte metabolism and distribution and shares many of the properties with sodium, potassium, and magnesium ions that are used in the conduction and excitation of muscle and nerve. It is thought that the positive effects of lithium on alleviation of depression might be due to its interactions with these ions and the resultant stabilization of the sodium pump and membrane potential that control intracellular sodium (Becker, 1977).

Sacher (1975) posited a third biochemical theory of depression after observing that psychotic depressives had increased frequencies of peak periods of cortisol production as compared with normals. He also observed that their cortisol production was double that of normals and did not slow at any time during the day, but after their depression lowered, the cortisol production and levels came back to near normal leading him to the conclusion that hypothalmic dysfunction was in some way involved in depression.

Ostroff, et. al., (1985) in a study of the norepinephrine to epinephrine ratio of 38 patients with a history of suicide found that they had a significantly lower ratio than a control group of 61 patients. This lends more support to the catecholamine hypothesis and the importance of norepinephrine levels on depression. Ostroff suggests that a low ratio of norepinephrine to epinephrine could be a risk factor in suicide behavior.

Although there is support for all the different biological theories of depression, there is no outstanding support of any one theory, indicating a need for further research in these areas.

The behavioral theories of depression are also many and inconclusive. The main ones are those of Lewinsohn, Ferster, and Wolpe. Lewinsohn's theory of depression states that it is caused by a low rate of response contingent positive reinforcement (RCPR). The low rate of RCPR seems to be due to three different reasons, (1), only a small number of reinforcing events are available in the environment, (2) few events are reinforcing and/or (3) the person, because he lacks the ability, very seldomly makes responses that would be reinforced. Depressive symptoms such as feelings of dysphoria or

fatigue are viewed as being the result of this low RCPR. The way to combat this low RCPR, as suggested by Lewinsohn, is to train the individual in skills to improve the rate of RCPR (Lewinsohn, 1974).

Ferster (1974) considered depression a problem due to extinction. A reduced rate of reinforcement due to unforseen changes to ones environment, change in reinforcement contingencies, little activity that elicits natural reinforcers, etc., was felt to lead to inactivity, and so, less reinforcing and thus continuing until depression resulted. Ferster suggested a program of activities graded in difficulty with a variable reinforcement schedule to change the inaction and emotionality of the depressed person's responses.

Wolpe saw conditioning as the cause of depression. Severe, prolonged anxiety was the cause of depression and anxiety was the result of less frequent and severe adversive conditioning. Feeling trauma approaching initiates conditioned anxiety, which activates avoidance behaviors. Severe or inescapable trauma causes learned or conditioned helplessness, which extinguishes the adaptive behaviors of avoidance response. Putting these together, when a person experiences severe prolonged anxiety, the result is non-responsiveness, or depression. To treat this, Wolpe suggested deconditioning of the inhibitory anxiety and a sequential series of success experiences (Wolpe, 1971).

Cognitive theories of depression are gaining in their popularity. The conscious and preconscious thoughts concerning one's self, experiences, and the world play a major role in the etiology and treatment of depression. The strongest influence in the cognitive approach is Aaron Beck (1967, 1974, 1979). Other cognitive

theorists include Martin Seligman, Albert Ellis, and Paul Hauck.

Seligman developed his theory of learned helplessness by observing dogs that were subjected to unavoidable (electric shock) stress and noticed that they finally quit trying to escape and later had extreme difficulty learning avoidance behavior. Applying this idea (not the shocking) to humans, Seligman suggested that depression was the result of unavoidable, unpredictable, and uncontrollable stress and this led to learned helplessness. The expectation that responding is futile is the basis of Seligman's learned helplessness in humans (Miller & Seligman, 1975).

Rational Emotive Therapy (R.E.T.) developed by Albert Ellis, (1962) involves 3 main variables: 1) the activating event; 2) the individual's belief about the event; and 3) the emotional consequence of 1 and 2. The emotional consequence, (3), is thought to be due to the individual's belief about the event, (2), not the event itself. Ellis' therapy was to change the individual's belief about the event, (2), and this would change the emotional consequence, (3), and therefore, the depression. Ellis has shown his technique to be useful but to a very select population and its usefulness to the general population has yet to be demonstrated.

Another cognitive theory of depression was that of Paul Hauck (1976). He saw three factors in depression: self-blame, self-pity, and other pity. By engaging in one or more of these, the result was depression. Hauck's treatment was for the individual to become more aware of these patterns and to substitute more realistic beliefs and patterns for them. His system was based on Albert Ellis' and little systematic research has been done.

Aaron Beck (Beck, Rush, Shaw, and Emery, 1979) in his cognitive theory of depression, viewed the depressed individual as being dominated by a "cognitive triad" whose main points were a negative view of self, of one's experiences, and of the future. The depressed person saw himself/herself as defective, inadequate, diseased, or deprived, and thought that because of his/her believed defects he/she was undesireable and worthless and also viewed his/her ongoing experiences in a negative way. The depressed individual also felt his/her problems would continue forever. Beck's therapy focused directly toward two aspects of depression: (1) overt symptomology that by itself is incapacitating and may increase the potential for suicide, and (2) "silent assumptions" or beliefs on which the individual operates daily and may predispose the individual to continuing depressions. The therapist attempts to help the patient modify the faulty belief system that is part of the individual's negative view of himself, his world, and future. The therapist and client work together to develop task assignments to clarify and test the client's interpretations of his experience, so as to help the client change the underlying assumptions that make up his unrealistic and self-defeating conceptions. Research on Beck's cognitive therapy has been promising (Hess, 1981) but more should be done.

In a well controlled study comparing Beck's Cognitive Therapy and behavioral treatment of depression, both were found to work equally well over a no treatment control group at the eight week termination of therapy and at a five month followup (Wilson, Goldin, Charbonneau-Powis, 1983).

As can be seen by the data, there are many inconclusive

theories as to the causes and treatments of depression, indicating the need for more research.

Physical Fitness and Psychological Variables

Physical exercise such as swimming, jogging, and running has long been accepted as a change agent in a person's physiology. It results in an improvement of the individual's muscular self, as well as increase in aerobic fitness (strengthening of the cardiovascular system). As more research is done, a case of psychological benefits from strenuous exercise has been developed. Cooper (1977), in his book The Aerobic Way, described a connection between a person's physical health due to aerobic exercise and one's psychological health.

Kostrubala (1976), in his book The Joy of Running, described a state of "feeling good" after acute physical activity. In a 1971 study, Morgan, Roberts, and Feinerman reported that neither anaerobic or aerobic exercise statistically changed subjects scores on anxiety or depression but that most of the participants reported "feeling better" after exercising. McPherson, et. al., (1967) tested subjects on a single strenuous exercise session and found that all subjects had positive mood changes after completion. Ismail and Trachtman (1973) had 60 middle-aged university faculty members participate in a four month aerobic program and found significant positive gains in personality variables using the Cattell Sixteen Personality Factors test when correlated with gains in aerobic fitness. Hartung and Farge (1977) found similar results when testing 48 male runners and joggers.

Nowles and Greenberg (1979) when testing 18 experienced joggers after participation in a 12.5 mile jog found that sadness and depression which started low ended with no evidence. Ewing, Scott, Mendez, and McBride (1984) tested 52 paid college students who half served as controls and half ran a submaximal test on the treadmill. They found that only the exercise group (on the treadmill) had enhanced positive mood. Thomas Collingwood (1971) while working with five male teen-agers in a three-week obesity program, got significant results after post-testing of increases in physical fitness performance, positive body attitude, positive self-attitude, positive self-acceptance, and significant decreases in real versus ideal self-discrepancy.

McPherson et al., (1967) studied personality and anxiety changes in post-infarct and normal men prior to, during, and after a 24-week exercise program and found that the post-infarct group had the greatest change in positive personality characteristics.

Contrary to most of the research that had been done, Hammer and Wilmore (1973), in studying 53 men engaged in a 10-week jogging program concluded that "personality factors have little bearing on physiological characteristics or alterations resulting from a 10-week jogging program."

Folkins, Lynch, and Gardner (1972) studied college students during a semester in school that participated in either jogging or in archery or golf. The group in the jogging class showed the greatest psychological improvement as measured by the authors.

Morgan (1976) tested 54 males from two different prison populations and randomly placed them in aerobic running groups or non-aerobic

control groups. The running groups reported an increase in sense of well-being and improvement in sleep characteristics. They also described a reduction in tension and depression when compared to the non-exercise control groups.

Zentner, (1981) in a well-designed experiment, ran an aerobic program for 10 weeks and tested 40 males and 40 females for 10 weeks before, during, and 10 weeks after the program. From his results, Zentner concluded after testing, "regular moderate running can precipitate a decrease in tension, depression, anger, fatigue, confusion, and increase vigor."

In a study relating selected biochemical and personality characteristics with aerobic exercise in the form of a 16-week program three days per week, Ismail and Young, (1977) found a significant relationship between an increase in physical fitness, an increase in norepinephrine levels, and a decrease in neuroticism and tension, lending support to the catecholamine hypothesis of affective disorders proposed by Schildkraut (1965).

Comparing physical fitness, selected personality traits, and urinary catecholamine metabolites, Sothmann and Ismail (1984) found a relationship between the catecholamine metabolite MHPG, fitness, and depression and concluded that "results suggest a biochemical reactivity syndrome involving MHPG that may relate to depressive personality characteristics."

Jasnoski, Holmes, Soloman, and Aguiar (1981) tested a 10-week aerobic conditioning class of 20 women and found a significant increase in aerobic capacity, abilities, and confidence but did not feel that the increase in abilities and confidence was due to the

improvement in aerobic fitness. Instead, they suggested that the improvement was due to other factors such as group participation or expectancies.

Bursten (1983) evaluated runners before and after a 12 kilometer run and the only significant change he found was a lowering of guilt scores following the run. He concluded that more research on individuals involved in a single strenuous exercise session should be done.

Goldwater and Coolis (1985), using one cardiovascular fitness group (N=27) and a placebo group set up to give the appearance of cardiovascular conditioning (N=24) tested 19 to 30-year-old males in a six-week program and found that the cardiovascular fitness group had a significant gain in aerobic fitness, reduction in anxiety, and a greater increase in general pyschological well-being.

Layman (1955) in his book Mental Health Through Physical Education and Recreation suggested that by being in poor physical shape makes one more likely to have poorer mental health. Research seems to support this but it is not clear which aspect leads to the other.

Griest et al., (1979) tested male and female out-patients diagnosed as schizophrenic after a 10-week running program and found no significant increase in fitness but did find a decrease in depression scores.

Kostrubala (1976) treated schizophrenics with a combination of running and psychotherapy and reported several cases of improved symptoms and lessening of the need for certain medications.

A number of studies have been conducted comparing physical fitness and phobias or anxiety neuroses. Eight agoraphobics were

treated successfully by Orwin (1973) by substituting running for the anxiety response of agoraphobia. In 1974, Orwin used running again successfully to treat a specific phobia. Muller and Armstrong (1975) used jogging to successfully treat a patient with elevator phobia. Driscoll (1976) used running in combination with desensitation to treat a student's test-taking anxiety.

Aerobic exercise has been successfully used to treat anxiety neurosis. Morgan (1973) found in a series of studies that state anxiety initially fell below the pre-exercise level with moderate to heavy exercise but not with light exercise. Fifteen men ran aerobically for 14 minutes and anxiety dropped below the pre-exercise level. On a maximal treadmill test using six normal and six anxiety neurotic males, Morgan found similar results (Morgan, 1973).

Sinyor and Schwartz (1983), in a novel experiment exposed 15 aerobically conditioned and 15 unconditioned males to psychological stressors and found that the heart rate and subjective arousal level increased significantly in both groups while being exposed to stressors but the conditioned group had higher levels of norepinephrine and prolactin early in the stress period, their heart rate recovered more quickly and they had lower levels of anxiety at the conclusion of the session. The authors suggested that aerobically trained individuals may be capable of faster recovery in both physical and subjective dimensions of emotionality.

The influence of physical fitness in determining the impact of stressful life events on physical and psychological health was the topic for research by Roth and Holmes (1985). They had 112 subjects report life changes for 12 months and then were tested with bike

ergometers for their aerobic strength. Then for 9 weeks they kept a record of their physical health and were tested for depression, anxiety, and alienation. Results indicated that a high level of stress during the preceeding year was due to poorer subsequent physical health, especially for subjects with a low level of fitness. Life stress was found to have little impact on subsequent physical health of fit subjects. Similar results were found for depression. The authors concluded that fitness does moderate the stress-illness relationship and suggest that increasing fitness may be a way of diminishing the effects of unavoidable stress.

Buccola and Stone (1975) tested geriatric patients after an aerobic conditioning program and found improvements in physical and cognitive abilities.

Wallach (1978) initiated jogging programs at Synanon for drug addicts and alchoholics and the treatment has become a regular part of their life at Synanon.

The reasons aerobic fitness may be able to positively affect an individual's mental health are numerous. Peoples (1983) indicates that maybe it is because of the release of the body's natural opiates, i.e., endorphins, or as in sensory deprivation, running leads to an "internal focus". He also mentions "competence motivation", that is, as one realizes he has the ability to do something, his confidence increases and his willingness to engage in activities that previously were too stressfull because of fear of failure, soars. Being "in control" as opposed to "learned helplessness" could be a cause for the "high" experienced by runners. Weltman and Stamford (1983) indicate that maybe the built-in rewards of exercise, the sense of accomplish-

ment, the increased working capacity, or improved self-esteem could be the reason or reasons for the psychological benefits of exercise.

Whatever the reasons, whether psychological or physiological, the benefits of physical exercise have been demonstrated, although much of the research has methodological errors. Folkins and Sime (1981) noted that the research in this area is fraught with design problems in experiments, little work has been done with normals, more attention needs to be given to individual differences, random selection of subjects should be adhered to, and more control should be put on experiments. More and better designed research is needed to investigate the method that physical exercise affects psychological health.

Depression and Exercise

One of the most common psychiatric disorders to afflict individuals is depression. It affects nearly one-half of all psychiatric patients and was found to be the most common psychiatric disorder in a well controlled study of a U.S. Community (Weissman, Myers, and Harding, 1978). Depressed individuals find it hard to perform physical tasks that would be easy for a physically healthy individual. Whether it is the actual physical working capacity of the individual or the emotional state has yet to be answered conclusively. Morgan (1968) compared the body fat, grip strength, reaction time, finger endurance, hemoglobin, and hematocrit of depressed and non-depressed male psychiatric patients at the time of their admission to a state hospital. The only significant difference was in the lower finger endurance of the depressed group. Another

finding of the study was that the patients who subsequently had longer stays in the hospital and thus were probably more ill, had a fitness level at admission lower than those who had shorter stays.

Morgan (1969) found that depressed male patients had significantly lower working capacity than non-depressed males. This result did not apply to the depressed females he tested, but he did find that the group of all hospitalized female patient's fitness was significantly lower than the general female population. (Morgan, 1970).

In another study, Morgan, Roberts, Brand, and Fernerman (1970) tested a "normal" group of 67 college faculty members and found that depression did not correlate with body fat, age, height, weight, grip strength, or physical working capacity and suggested that depression and physical fitness were not correlated in normal adult males. Interestingly, all of the subjects that scored in the depressed ranges on the Zung Depression Scale increased their physical working capacity and all scored in the non-depressed range upon completion of the program. All the other participants started and ended in the non-depressed range.

Hartz, Wallace, and Cayton (1982), studied seven clinically depressed men and women engaging in a 6-week fitness program. Two of the subjects had a significant lowering of depression on the Depression Adjectives Checklist (DACL) and the Zung Depression Inventory. The other five had lower depression scores but these were not significant. Interestingly, only the two subjects showing a significant drop in depression had a significant gain in aerobic fitness.

Holder (1983) tested elderly volunteers in an 8-week aerobic program and measured blood pressure, heart rate, and depression. His results showed a significant lowering of a diastolic blood pressure as well as a significant drop in depression in elderly men as compared with controls.

In another study of 35 older femaleadults engaged in an 8-week, two times per week fitness program, Bennett, Carmack, and Gardner (1982) found no significant lowering of depression scores on the Zung scale. But for a sub-sample of individuals in the group that had depression scores on the Zung higher than 50 (N=11), these subjects had significant lowering of depression scores.

Blue (1979), tested two former in-patients who had unsuccessfully been involved in anti-depressant drug therapy and cognitive behavioral depression therapy and they both agreed to get in an aerobic fitness program based on Cooper (1977) that met for two runs per week at the clinic and one run per week on their own. After three weeks, patient number one was down significantly from the moderate to minimally depressed range. The author concluded that although the design was not experimental that the study did give hope of help for depressed individuals through exercise.

Hannaford (1984) tested 25 male subjects involved in a V.A. centerd day-treatment program where they exercised three times per week for 10 weeks for 30 minutes at 60 percent of their maximum heart rate and compared them to a corrective therapy group (non-cardiovascular) who exercised three times per week for one hour. The author tested subjects in both groups for cardiovascular strength, depression, anxiety, and self-esteem. The cardiovascular group

experienced significant gains in aerobic fitness as well as a significant drop in depression, although no drop in anxiety or gain in self-esteem was significant. The non-cardiovascular group had no significant changes.

Sanstead (1984) tested 14 women and 1 man in a 10-week aerobic program and found significant gains in fitness of 80 percent of the subjects and a lowering in depression but the experiment was tainted due to the irregular attendance of the majority of the subjects.

Byrom (1984) measured depression, anxiety, self-concept, and perceived physical fitness in 29 college women before and after a 15-week cardiovascular fitness program. He found that the cardiovascular group had a significant increase in self-concept, were less anxious, and perceived themselves to be more fit than a control group of 25 women engaged in bowling, golf, or archery. Byrom found not significant lowering of depression scores for either group.

Goodrich (1984) measured change in depression, hostility, and resting pulse of 44 college students entered in a weight training class, half of which participated in aerobic weight training and half which participated in traditional non-aerobic weight training. The aerobic weight training group had significant lowering of both resting pulse and depression, but not hostility. The non-aerobic group had no significant changes.

Hull, Young, and Ziegler, (1984) measured the effects of aerobic fitness on levels of catecholamines and personality variables. Norepinephrine levels were lower after nine minutes of exercise in fit subjects, but was much higher than in pre-testing, after completion of exercise. Only anger and depression showed fitness related

decreases.

Jesting (1981) used the DACL to measure depression in 100 young adults engaging in two races of 3.1 and 9.3 miles. She found a significant (P .01) drop in depression and brought up a valid point, "does running make people less depressed, or do less depressed people choose running?"

Marshall (1984) compared individuals in aerobic dance (N=18), social dance (N=13), and an academic class (N=19), on measures of aerobic fitness, anxiety, and depression. She found that all groups except the aerobic dance class showed significant increases in depression from the first to the eighth week. Anxiety scores were non-significant for all groups.

Weaver (1985) ran a study to determine the effect of aerobic exercise on depression in 50 middle-aged women. She found significant (P .05) reductions in the level of depression.

On a study of 11 male subjects, 40 to 60 years old, who as experienced joggers were running 10 to 30 miles per week, Lobstein (1983) used the MMPI (Minnesota Multi-Phasic Inventory) to measure personality variables. After four months, the only difference between the jogging and control groups on any of the scales of the MMPI was a lower depression score for the jogging group. The author stated that the primary difference between the low-fit and the hi-fit groups was depression.

Kavanagh, Shepard, and Tuck (1975) tested 56 severely depressed post-coronary males using the MMPI. After engaging in a regular running program, they showed a significant reduction in their levels of depression. A four year followup of 44 of these subjects showed

that they retained the results (Kavanagh, Shepard, Tuck, and Qureshi, 1977). Of further interest was that the greater drops in depression were experienced by those who adhered fully to the prescribed routine and that those who didn't showed very little decrease in depression.

Brown, Ramirez, and Taub (1978) tested 167 university students engaged in jogging, wrestling, and softball. Although no significant gain in aerobic fitness was found for any of the groups, the jogging and wrestling groups did show a decrease in depression. In a second study done by Brown, Ramirez, and Taub (1978), 480 normal and 101 depressed college students that participated in a 10-week aerobic fitness program were assessed. They found that both the non-depressed and depressed groups had significant drops in depression, also the depressed jogging group had significant drops in the negative affective states of anger/hostility, fatigue/inertia, and tension/anxiety, and significant increases in the positive affective states of cheerfulness, energy, and general activation. Brown (1978) suggested that the effects shown were biochemical as well as psychological. He felt a network of factors were involved, like proprioceptive feedback from the musculoskeletal system to the brain, catecholamine enhancement, greater blood flow to the brain, or salt loss from sweating and hypothermia.

Looking at the majority of these studies, it would seem to indicate that depression is positively affected by physical fitness. The amount of this effect seems to be mitigated by, in part, the initial state of the individual and the type of exercise engaged in. The worse the depression in an individual, the more positive the

pyschological gains from physical exercise. It also was common to find that the more vigorous the exercise, the more pyschological benefits were gained from it.

Greist, Klein, Eischens, and Faris (1978) in an original study, compared the effects of time-limited psychotherapy, time-unlimited psychotherapy, and jogging as treatments for moderately depressed patients. The time-limited pyschotherapy focused on immediate change that could make the subject feel better, the time-unlimited psychotherapy was more dynamic or insight-oriented in nature. The program ran for 12 weeks with the running group meeting three times per week for group runs. At the end of the 12 weeks, subjects in the time-limited therapy and jogging group had statistically lowered their depression scores from initially moderate levels to a finishing level of "a little bit" of depression. The time-unlimited group experienced no change. At a one year followup the jogging group showed almost no depression, while the time-limited group was still scoring in the "a little bit" of depression range, and the time-unlimited therapy group was still in the moderate range. The authors suggested that different factors of the jogging program, i.e., social participation, biochemical changes, success training, etc., were probably individually responsible for the positive change in this group. Greist, et al., noted that some of the subjects might consciously substitute running, a positive addiction, for other negative addictions that contributed to them feeling depressed, as theorized by William Glasser (1976) in his book, The Positive Addiction.

In a 12-week study of the effects of cognitive-behavioral depression therapy and an aerobic running program on a group of 12 moderate to severely depressed subjects, Buffone (1980) found no changes in dependentvariables in a four week baseline (no treatment) period but after treatment for eight weeks there was a significant reduction in depression level as measured by the Beck Depression Inventory (BDI), increased self-confidence, reduced anxiety, and improved body image. As there was only one treatment group, it is hard to speculate on which effected the psychological improvement.

Hess (1981) compared the effects of Beck's cognitive therapy, jogging treatment, and no-treatment in alleviating depression in 17 depressed out-patients. Both the cognitive therapy group and the jogging treatment group experienced significant reductions in their levels of depression.

In a similar study, Rueter (1981) tested 22 moderately to severely depressed college students who for ten weeks either engaged in counseling therapy or running therapy. She found that upon completion of the 10-week period, only one person in the jogging group (N=9) indicated depressed symptomology as measured by the Beck Depression Inventory, while four of the counseling therapy (N=9) group still exhibited significant signs of depression, indicating that in this study for whatever reasons, jogging had been more effective at alleviating depression that this type of counseling therapy.

Fremont (1984) compared the effects of cognitively based counseling and aerobic exercise for the treatment of mild and moderate depression. He assigned 49 volunteers to one of three

groups: running, counseling, or combined. All three groups had significant and nearly equal reductions in depression scores. The most dramatic improvements were noted to take place in the first three weeks. The running program met for 20 minutes three times per week, which might not have been strenuous enough to give a significant aerobic gain. No control group was used.

In a very well designed and controlled study of the influence of aerobic exercise on depression, McCann and Holmes (1984) tested 43 depressed women in one of three groups. Fifteen were randomly assigned to an aerobic exercise group, 14 to a placebo (relaxation exercises) group, and 14 to a no-treatment control group. The aerobic group participated in a program based on the work of Cooper (1968) and experienced a significantly greater gain aerobic fitness ($P < .002$ in both cases) than any of the groups. The aerobic exercise group also showed greater drops in depression as compared with the placebo group ($P < .001$). Although this experiment does not show how exercise affects depression, it did demonstrate that participation in a program of strenuous aerobic exercise was effective for reducing depression. The use of a placebo and a no-treatment control group also lends credibility to the results attained in this study.

The Present Investigation

The results of the McCann and Holmes (1984) study lend significant weight to the use of aerobic exercise as a means to lessening depression. It is one of the latest in a series of anecdotal and experimental studies giving support to the notion of aerobic fitness to relieve depressive symptomology.

Depression is currently the most frequent kind of psychopathology diagnosed by physicians (Oliver & Simmons, 1984). Suicide is the third leading cause of death in teenagers. The initial interest in aerobic physical exercise in the form of jogging appears to have been stimulated firstly by the "feeling good"phenomenon associated with exercise (Cooper, 1968). Even though the exercising may be very strenuous, grueling, and physically exhausting, people report that they feel good after they finish. It has been suggested that some types of depressions are associated with low levels of norepinephrine in the central nervous system (Schildkraut, 1965; Sothman and Ismail, 1984) and thereby relieve depression.

It is also possible that running could provide a form of depressive symptom relief and a distraction from somatic symptoms. Some runners experience a change in consciousness similar to a drug or meditation-like high (Kostrubala, 1976).

Greist, et al., 1979, suggested that aerobic exercise may effect depression in other more cognitive ways. A sense of mastery, patience, and the knowledge for self-change, and improved self-concept experienced by runners could lead to a lessening of depression.

If physical exercise does lead to a reduction in the level of depression, this would have great impact on the fields of psychiatry, psychology, social work, and many other mental health professions. Running or aerobic exercise might not be an effective treatment for all people suffering from depression, but could be used successfully in the case of many of those afflicted.

Aerobic exercise has many advantages over other forms of treatment for depression, such as drugs, psychotherapy, electro-conclusive therapy, etc., in that it can be done alone, inexpensively, takes little time, has very few bad side effects, and has the added benefit of physical fitness.

This investigation is an attempt to determine if an increase in aerobic fitness is associated with a corresponding decrease in a normal population of adults.

Chapter II

METHOD

The purpose of this study was to determine the relationship between aerobic fitness and depression. Depression levels and aerobic fitness were measured before and after a 10-week aerobic fitness program. Aerobic fitness was assessed by the Astrand Adaption of the Harvard Step Test and depression levels were measured by the Beck Depression Inventory (BDI) and the Zung Self-Rating Depression Scale (SDS).

Subjects

Subjects for this experiment were individuals who registered for a noon-time adult fitness class set up by the author for the purpose of this study. The ages of subjects ranged from 19 to 43 years. Twenty-nine individuals were initially tested. Of these, 13 dropped out due to time conflicts. Sixteen were in the experimental group but five dropped out due to complications brought about by the volcanic eruption of Mt. St. Helens. Three more subjects were unavailable for post-testing. This left eight females in the final experimental group. The control group of individuals not enrolled in the fitness class consisted of four males and four females. Subjects for the control group were volunteers from other physical education activity classes taught by the author. This could have been a contributing factor to the control group being in better physical condition at the beginning of the experiment.

Instrumentation

Subjects for this experiment all signed an Informed Consent Form prior to participating and completed a Beck Depression Inventory, Zung Self-Rating Depression Scale, Physical Activity Index, and Astrand Step Test. At the completion of a 10-week period, all subjects were reassessed using the same tools.

Beck Depression Inventory (BDI). The BDI is a 21-item test, each item being scored on a four-point scale for degree of severity. A score of zero means almost none of the symptom described, while a score of three means the symptom applies very strongly to the test taker, a score of 63 on the entire test is maximum. The categories were developed by comparisons of BDI scores with clinician's ratings (Beck, Ward, Mendelson, Mock, and Erbaugh, 1961). Items were initially taken from clinical observations of attitudes and symptoms of depressed patients. Test items fall into three main areas, somatic, cognitive/attitudinal, and motoric. All items have been found to be related significantly to total score (Campbell, Burgess, and Finch, 1984). Oliver and Simmons (1984) in comparing depression as measured by the DSM III and the Beck Depression Inventory concluded after extensive study, "Findings from the current study suggest that the BDI is a sensitive screening instrument for detecting depression in community populations." Beck (1967) reported on 200 cases in which the score for each of the 21 items was compared with the total score on the BDI for that individual. Using the Kruskal-Wallis Non-Parametic Analysis by Ranks it was found that all items showed a significant relationship to the total score ($P < .001$ for all items

except number 19, weight loss, which $P < .01$). An item analysis of 606 cases showed that the items correlated positively with the total score (range .31-.68). All correlations were significant at the .001 level (Beck, 1967). Internal consistency measured by using split-half reliability calculated using odd and even categories gave a Spearman-Brown coefficient of .93 (Beck, 1967). Scores on the BDI were very similar to clinician's ratings when the test was administered over time to 38 patients (Beck, 1967). To assess concurrent validity BDI scores were compared with the evaluations of four trained psychiatrists on depth of depression. Using a Krushal-Wallis One-Way Analysis of Variance by Ranks to evaluate statistical significance of the difference between main scores, gave a $P < .001$ (Beck, 1967). In a 1984 study to assess the internal consistency of the original and the revised BDI, Beck and Steer (1984) found the original BDI to have an internal consistency of .88 and the revised BDI to have an internal consistency of .86. Also, they reported that the BDI has been used in over 500 published studies to 1983 (Beck and Steer, 1984). Working with older adults, Gallagher, Nies, and Thompson (1982) found the BDI to have "respectable internal consistency and stability and is adequate as a screening devise with the elderly." Rush, Hollan, Beck, and Kovacs (1978) reported correlations of .85-.86 between the BDI and the Hamilton Rating Scale. For discrminant validity in a study of 606 patients the BDI scores correlated .59 with clinical ratings of depression and .14 with clinical ratings of anxiety. With all the research done the BDI has been found to have good validity, and suggests that the BDI is a good self-report

measure for assessing level of depression.

Zung Self-Rating Depression Scale (SDS): The Zung Self-Rating Depression Scale contains 20 items relating to specific characterisitcs of depression. Items for the scale were chosen because they were the most common characteristics of depression found in the literature. The subject answers the items by using one of four quantitative descriptors from "none or little of the time" to "most or all of the time." The final score is expressed as a percentage. Scores below 50 indicate mild depression, 60 to 69 indicates moderate to marked depression, and scores over 70 indicate severe to extreme depression. Split-half reliability using odd-even correlations was found to be .73 (Zung, 1973). In a 1978 study by Biggs, Wylie, and Ziegler comparing scores on the SDS with ratings of the treating physicians, and with scores on the Hamilton Rating Scale (HRS), the correlation between the SDS and the HRS was .80. The correlation between the physicians ratings and the SDS was .69. The SDS was able to separate levels of severity of depression, as based on physicians ratings, at the significance level of .05 (Biggs, Wylie, and Ziegler, 1978). Other studies have found significant relationships between the SDS and other measures of depression such as the Beck Depression Inventory (Zung, 1969), and the depression scale of the MMPI (Zung and Richards, 1965). The SDS' discriminatory power between depression and other categories such as anxiety reactions, "normals", personality disturbances, and psychophysiological disorders has been demonstrated to be significant by a number of studies (Zung, 1965, 1967; Zung,

Richards, and Short, 1965). The SDS appears to have adequate reliability and validity, and thus should be useful for this study.

The Astrand Adaption of the Harvard Step Test. The Astrand Step Test predicts physical fitness in the form of maximum oxygen uptake (Max VO_2) or the maximum ability to take in, transport, and use oxygen. The most accurate method to measure maximum oxygen uptake is the treadmill test which takes considerable time and special equipment. The Astrand Test was found to correlate well with the treadmill test (.65 to .77, Astrand and Rhyming, 1954; Teraslinna, Ismail, and MacLeod, 1966). The test consists of stepping on and off a bench, 13 inches high for women and 15-3/4 inches high for men, for five minutes in time to the beat of a metronome set at 90 beats per minute. At the end of five minutes the subject sits and at exactly 15 seconds after the test ended the pulse is taken for a period of 15 seconds. The fitness score for the subject is then calculated on a special graph (Sharkey, 1977) using the post-exercise pulse, body weight, sex, and age.

Physical Activity Index (PAI). The PAI is a self-report measure of gross level of physical activity. It measures the areas of intensity, duration, and frequency of activity. Intensity refers to the training heart rate, duration to the length of time in minutes of exercise, and frequency to the number of exercise sessions per week or month (Sharkey, 1977). The three areas are weighted 5, 4, and 5, through cross multiplication can yield a maximum score of 100. The resulting score is converted to a general descriptor of the subjects

fitness. Scoring below 20 gives a low-fitness of sedentary lifestyle rating, 20 to 40 indicates below average fitness level. Scoring in the 40 to 60 range gives an average level of activity leading to medium fitness. Sixty to 80 indicates an active and healthy lifestyle and 80 to 100 suggests a very active lifestyle and high fitness (Sharkey, 1977). Sharkey (1979) reported that the resulting score on the PAI is "highly related to aerobic fitness."

Procedure

Subjects were individually given all of the physiological and self-report measures prior to and at completion of a 10-week period. Subjects also completed an Informed Consent Form prior to engaging in the study.

The adult fitness program was one designed by the author to concentrate primarily on improvements in the aerobic strength or cardiovascular health of the subjects. The program was designed to meet the individual fitness needs of the participants. Each workout consisted of a period of stretching, calisthenic warm-ups, a run-walk period, and a cool-down period. The run-walk period was individually geared and was based on the exercise heart rate of the subjects. Distance, time, and intensity were continuously increased to keep the subject in a "training zone" so as to receive maximum aerobic benefit from the exercises (Sharkey, 1977). The subjects exercised with a group leader three times per week for 10 weeks. Also, participants in this class kept a log of other extra-curricular activities that they engaged in. Workouts were held indoors on rainy days and

outside when weather permitted. The lowest fit subject at the beginning of the program could run 1/10 of a mile before having to quit, by the end of the program she was running for 1/2-mile, walking 1/4-mile, and then running another 1/2-mile. The highest fit subject could run 3 miles at the beginning of the program and by the end she was running up to 110 minutes non-stop, which was over 10 miles.

Statistical Analysis. An analysis of variance with repeated measures analysis of the dependent variables was used to test for significance on all outcome measures. The ANOVA tests significance from pre-test to post-test for dependent variables in treatment and control groups and any significant interactions between these. The .05 level of significance was employed for all measures.

Limitations of Study. Certain conditions possibly affecting the experimental conditions should be taken into consideration when interpreting the results of this study. Subjects for this experiment were volunteers giving no opportunity to match treatment and control subjects for age, sex, activity level, weight, etc.. Because of the program being strictly volunteer and dropout due to unforseen circumstances, (volcanic eruption, etc.) the experimental group consisted of eight females. Due to these same reasons, the subjects in the control group that were available for post-testing consisted of four males and four females. The offering of an adult fitness class could have an effect of attracting less fit individuals than the average of the general population. Also, the 10-week fitness program was seriously interrupted for a two-week period by the volcanic

eruption of Mt. St. Helens which definitely could have had an effect on the physical fitness gains of the program.

Chapter III

RESULTS

This study was mainly interested in change from pre-test to post-test scores. The experiment was initiated to see if level of depression in "normal" subjects was affected by an increase in activity and/or aerobic fitness. The Beck Depression Inventory, Zung Self-Rating Depression Scale, Physical Activity Index, and Astrand Step Test were used to assess these areas.

The statistical tool used to assess the significance of the test scores was an analysis of variance (ANOVA) with repeated measures. The ANOVA was used to determine if the experimental and control groups differed significantly between groups and from pre- to post-test on the four dependent variables, i.e., BDI, SDS, PAI, and Step Test. The null hypothesis was used for statistical computations. The $P = .05$ level of significance was used in all analyses.

Results of the analysis of the Beck Depression Inventory scores indicated that the main effect for pre-post was highly significant ($P < .01$, $F=9.434$, $df=1, 14$). The experimental groups pre-test mean was 10.37 and at post-test the mean was 4.5 (Figure 1). The control group began and ended with the same mean level of depression as measured by the BDI while the experimental group's mean lowered by 5.87 points. It also showed a significant difference between groups.

The Zung Self-Rating Depression Scale scores after analysis revealed a highly significant main effect for pre-post ($P < .01$, $F-10.312$, $df=1, 14$) (Figure 2). Even though the experimental group

had a large decrease in level of depression as measured by the SDS, the control group also had a decrease in depression, although smaller, and the difference between the two groups was not sufficiently large enough to be significant. The experimental group started at a higher level of depression than the control group and ended at a lower level of depression dropping almost nine points as compared to less than three points for the control group but this difference was not large enough to be statistically significant.

Analysis of the Astrand Step Test revealed a significant difference between experimental and control groups in level of fitness from pre- to post-test ($P < .05$, $F=8.401$, $df=1, 14$). The control group scoring significantly higher on the Step Test at pre-test was probably due to less fit individuals being attracted to an adult fitness porgram (experimental group). Also, differences between the control and experimental group could be due to the experimental group consisting entirely of females (N=8) and the control group being made up of four males and four females (N=8). Male subjects have been demonstrated to have a mean max VO_2 higher than females of the same age (Sharkey, 1979). Another possible cause of this difference was the mean age of the two groups. The control group had an average of 22 years while the experimental group had an average age of 32.875. It has been shown that the older an individual gets, the max VO_2 has a subsequent drop (Sharkey, 1979).

There was no significant interaction between the control and experimental groups from pre- to post-test, both groups experienced almost identical gains in fitness from pre- to post-test. This

finding could have been due to post-test measurements being taken 10 days after the volcanic eruption of Mt. St. Helens, thus negating any significant gain in aerobic fitness of the experimental group due to the fitness program. Another possible reason for the lack of interaction between groups as measured by the Step Test could have been that the control group had been selected from individuals in activity classes taught by the author. This fact could mean that the control group was getting as much aerobic exercise as was the experimental group, thus minimizing any difference in gain of fitness between groups.

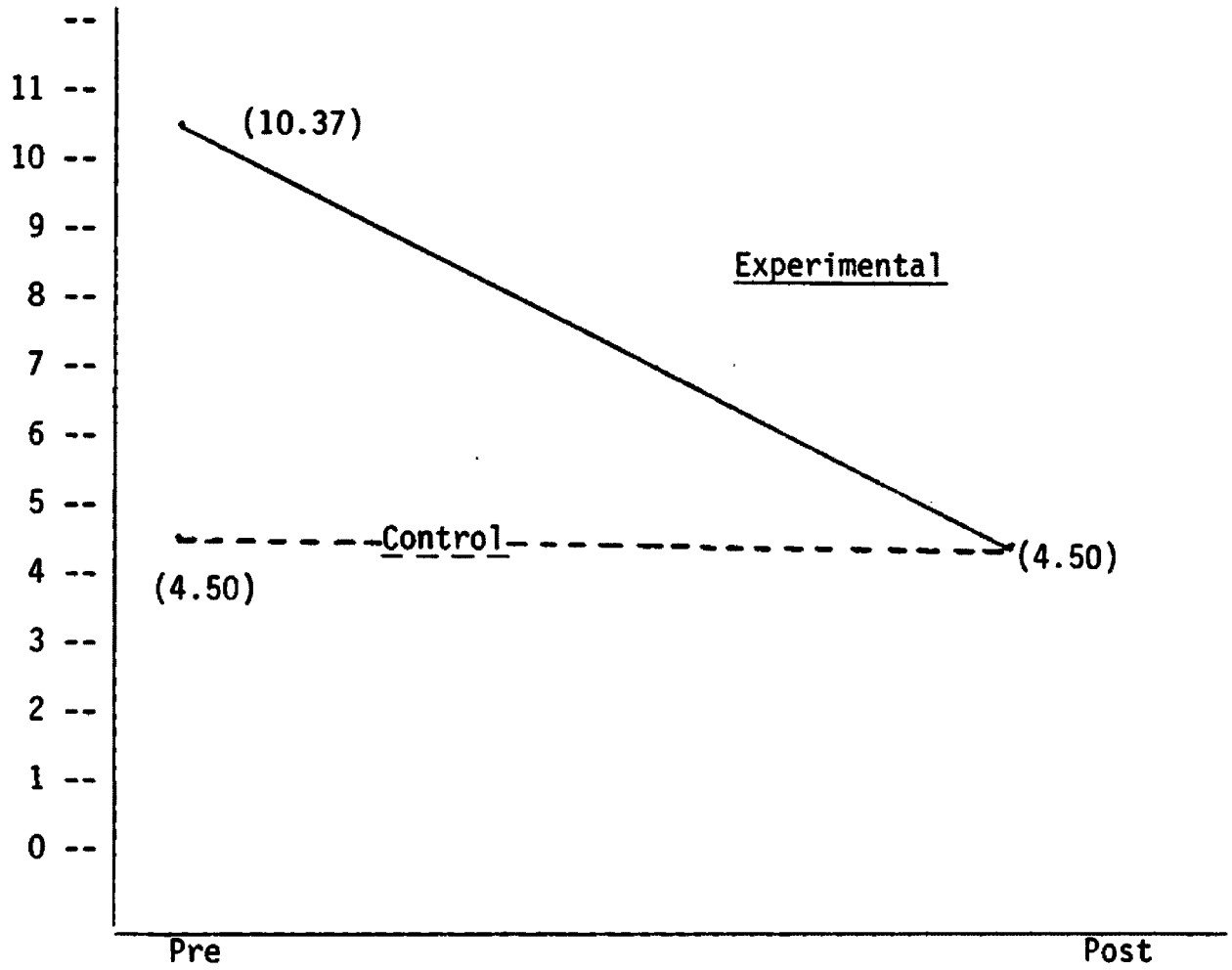
The analysis of the Physical Activity Index indicated a highly significant main effect for pre-post ($P < .01$, $F=13.804$, $df=1, 14$) and a significant interaction effect ($P < .01$, $F=4.891$, $df=1, 14$). The experimental group had a pre-test mean of 22.12 and a post-test mean of 55.62, a gain of 33.5 points while the control group had a pre-test mean of 38.0 and a post-test mean of 46.5, a gain of 8.5 points on the PAI (Figure 4). These results demonstrated good experimental control with the hoped for significant increase in activity of the experimental group. The control group started at a higher level of activity but ended up at a lower level as reported on the PAI.

The significant increase of activity of the experimental group along with a significant drop in level of depression has been supported by much of the literature (Greist, et. al., 1979; Hess, 1981; Holder, 1983; Weaver, 1985). These studies and others has supported the notion that gains in physical fitness need not be significant to precipitate a decrease in level of depression but by

increasing the amount of activity the person is engaged in, a lowering of level of depression is likely to be found.

Figure 1

Beck Depression Inventory



Summary Table

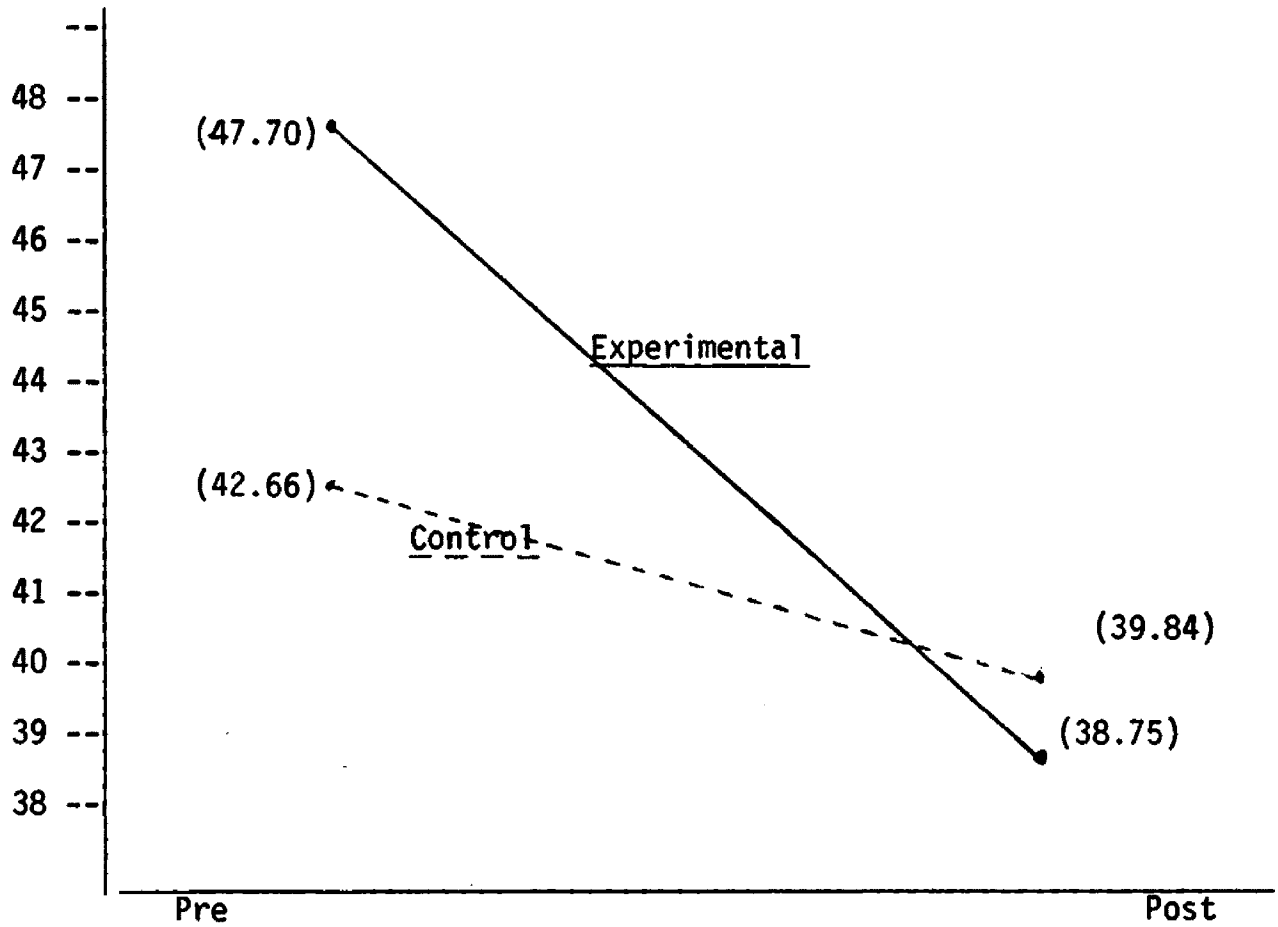
	Sum of Squares	Sum of Squares	df	F-ratio	Prob.
A	69.0313	69.0313	1	1.065	0.32073
J	69.0313	69.0313	1	9.434	0.00817**
AJ	69.0313	69.0313	1	9.434	0.00817**
Error I	907.438	64.8170	14		
Error II	102.438	7.31696	14		

A: Experimental/Control
J: Pre/Post
AJ: Interaction

*P < .05
**P < .01

Figure 2

Zung Self-Rating Depression Scale



Summary Table

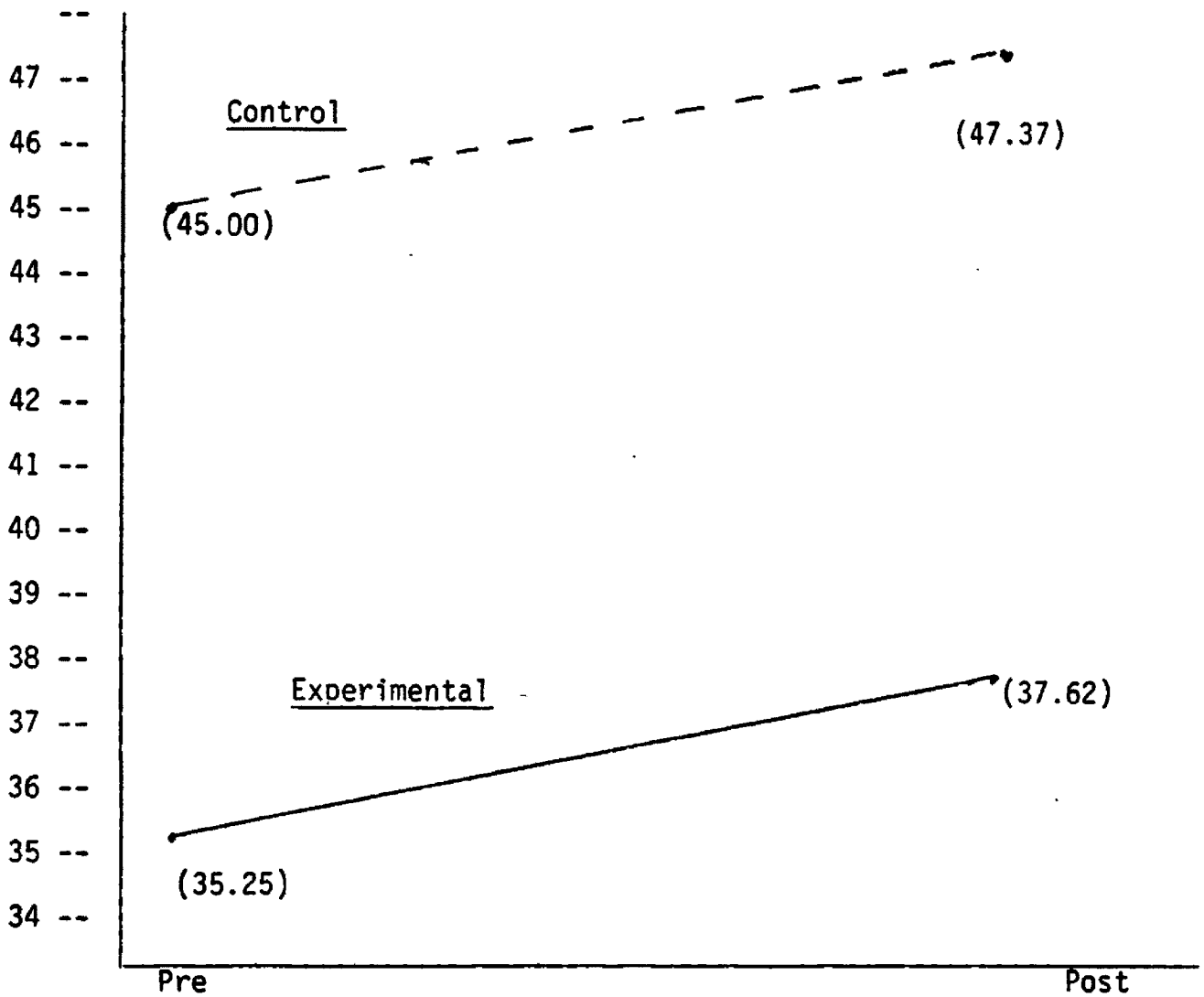
	Sum of Squares	Sum of Squares	df	F-ratio	Prob.
A	31.5020	31.5020	1	0.142	0.71238
J	277.596	277.596	1	10.312	0.00631**
AJ	75.7988	75.7988	1	2.816	0.011248
Error I	3106.65	221.904	14		
Error II	376.887	26.9205	14		

*P < .05

**P < .01

Figure 3

Step Test



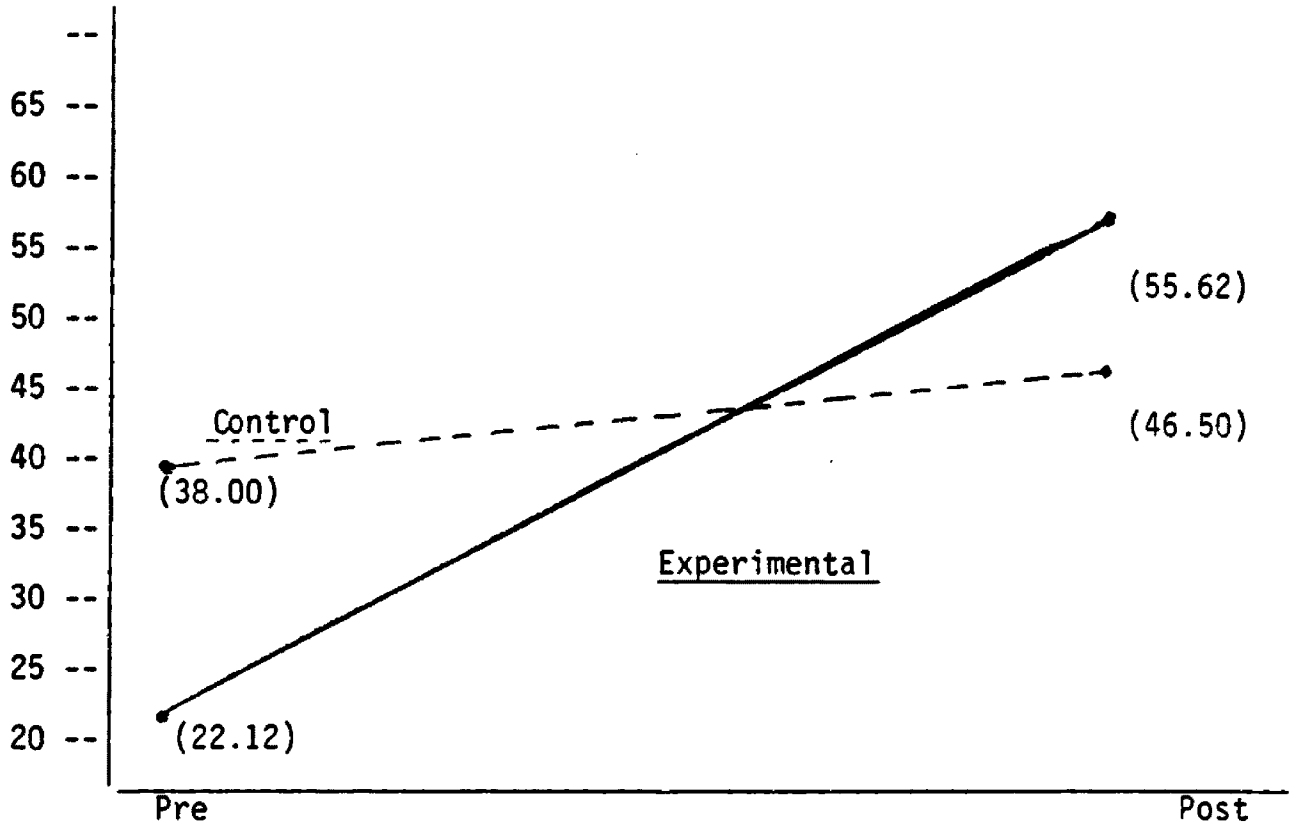
Summary Table

	Sum of Squares	Sum of Squares	df	F-ratio	Prob
A	760.500	760.500	1	8.401	0.01132*
J	45.125	45.125	1	3.327	0.08661
AJ	0.000	0.000	1	0.000	1.0000
Error I	1267.380	90.527	14		
Error II	189.875	13.562	14		

*P < .05
**P < .01

Figure 4

Physical Activity Index



Summary Table

	Sum of Squares	Sum of Squares	df	F-ratio	Prob
A	91.125	91.125	1	0.277	0.61229
J	3528.000	3528.000	1	13.804	0.00258**
AJ	1250.00	1250.00	1	4.891	0.04208*
Error I	4608.750	329.196	14		
Error II	3578.00	255.571	14		

**P < .05
*P < .01

Chapter IV

DISCUSSION AND SUMMARY

The results of this 10-week adult fitness program indicated a significant drop in depression for the experimental group as measured by the Beck Depression Inventory. With a small number of subjects in the groups, it takes large differences to give significant results, demonstrating the powerful effects of the fitness program in this instance. The program of physical fitness was also effective in increasing the experimental groups level of activity.

The decrease in depression as demonstrated by the Beck Depression Inventory supported the findings of other authors (Brown, et. al., 1978; Rueter, 1981; Zentner, 1981; Hartz et. al., 1982; Marshall, 1984; McCann, 1984; Hannaford, 1984; and Weaver, 1985).

Many authors (Marshall, 1984; Hannaford, 1984; Hartz et. al., 1982) have suggested a need for there to be an increase in aerobic fitness and that exercise should be vigorous to precipitate a drop in depression. This study did not support that finding. There was no significant increase in aerobic physical fitness to accompany the decrease in depression. That no increase in max VO_2 was demonstrated could have been due to the design of the adult fitness program but was most probably due to the eruption of Mt. St. Helens which interrupted the aerobic program for two weeks, ten days prior to post-testing, thus possibly having the effect of neutralizing any major gains in aerobic fitness for the experimental group. But the literature shows many studies (Greist et. al., 1979; Blue, 1979;

Jesting, 1981; Hess, 1981; Holder, 1983; and Fremont, 1984) where levels of depression decreased without an accompanying increase in physical fitness. This brings up the question 'Does the fitness gain have to be significant to result in an accompanying drop in depression?' A number of authors (Blue, 1979; Fremont, 1984; Hess, 1981; and Holder, 1983) have noted that the most significant drops in level of depression have been in the first few weeks of the fitness porgrams, where there was no corresponding gain in physical fitness as measured by tests such as the Step Test, 12 minute run, and 1-1/2-mile run. This may not mean that there was no fitness gain, only that these tests were not sensitive enough to pick it up, or unable to discriminate between groups, or were administered less than perfectly. Maybe using more reliability checks on these tests would help or using more sensitive tests such as the treadmill or bicycle ergometer test to measure max VO_2 would help to discriminate between groups and be more likely to pick up more accurately gains in aerobic fitness.

Although the Zung Self-Rating Depression Scale did not reveal a significant drop in level of depression for the experimental group as compared to the control group, it did show a significant drop ($P < .01$, $F=10.312$, $df=1, 14$) for both groups from pre- to post-test. The reason the interaction between groups was not significant was because even though the experimental had a large drop in depression score, the control group also had a drop in depression and the variance between groups was not large enough to be statistically significant. Both groups still had a significant drop in depression

scores as measured by the SDS, with the experimental dropping three times as much as the control group (experimental group = -8.95, control group = -2.82). The fact that both the experimental and control group experienced drops in level of depression as measured by the SDS could have been attributable to the control group being selected from individuals in various activity classes taught by the author, and their being engaged in physical activity might have had the affect of contributing to a lowering of depression as measured by the SDS.

The BDI interaction scores for a drop in level of depression were significant but the SDS interaction scores did not reach the .05 level of significance. This result might be due to the design of the instruments. One difference that might have caused this variation in scores was the difference of instructions for using the two devices (Appendix A). The SDS was given with the instruction to fill in the form as the person felt right at that moment with no specific time period to look back upon. In the BDI instructions the subject is instructed to "pick out the one statement in each group which best describes the way you have been feeling the PAST WEEK, INCLUDING TODAY." This difference in instructions might of affected the way the subjects responded to the items on each of the inventories.

The two groups were significantly different from pre-test to post-test on the Step Test ($P < .05$, $F=8.401$, $df=1, 14$). This could have been due to a number of reasons. The average ages of the two groups were quite different (experimental = 32.875 years, control 22.0 years). As one gets older, their max VO_2 has a continuing

decline (Sharkey, 1979). Another possible reason for this difference was that the experimental group was made up of eight women and the control group was made up of four men and four women. The mean score of the women in the experimental group was pre-test = 39.75, post-test = 43. While the mean score of the men in the control group was pre-test = 50, post-test = 53.5. This clearly indicates that the men of the control group were scored considerably higher than any of the women. This is in congruence with research (Sharkey, 1979). The difference between the groups in aerobic strength at the pre-test could also have been indicating that less fit individuals are attracted to an adult fitness program.

The experimental group was more depressed as measured by the BDI and SDS at pre-test than the control group (BDI, E=10.4, C=4.5; SDS E=47.7, C=42.66). This could have been a fitness as well as activity level related effect. More depressed people are less likely to engage in strenuous activities (Becker, 1977; etc.). The experimental group had a much lower level of activity as indicated by the Physical Activity Index at pre-test (E=22.12, C=38.00). The experimental group also had a lower level of aerobic fitness at pre-test as measured by the Step Test (E=35.25, C=45.00). These findings supported research by Lobstein, 1983, where he found that men jogging 10 to 30 miles per week were significantly less depressed than sedentary people. (Five of the control group in the current study were jogging regularly at the outset of this program). These findings also supported a 1985 study by Roth and Holmes where they found that individuals (N=112) that were in better shape physically

were better able to handle life stress and were less depressed than individuals in poorer physical condition.

Along with this difference between the control group and the experimental group on the Step Test was a difference at pre-test between the control and experimental groups on levels of depression (BDI, C=4.5, E=10.37; SDS, C=42.66, E=47.70). These measures indicating that the control group had a lower level of depression at pre-test could have been due to their being in better aerobic condition and an exercise related drop in level of depression had already been experienced and was being continued (as evidenced by the lower scores) at the testing times.

There was, as hoped for, a significant increase in activity level as measured by the Physical Activity Index ($P < .05$, $F=4.891$, $df=1, 14$). This indicated good experiment control of the adult fitness program. The significant increase in physical activity without a significant gain in fitness but with a significant lowering of level of depression supported research done by Blue, 1979; Fremont, 1984; Holder, 1983; etc. Activity level alone and engaging in social participation could have possibly helped to reverse the depressive syndrome (Becker, 1977; etc.). By definition a depressed person is prone to inaction so any increase in physical activity level could have the affect of breaking the depressive symptomology and of lessening the level of depression. This finding is very important and supports the research done by others (Holder, 1983; Hess, 1981; Weaver, 1985; etc.). Future research should be carried out to assess just what level of activity is needed to precipitate

a drop in level of depression and to find out if as the level of activity increases is there an inverse and equal drop in level of depression.

When asked at the end of the program of their subjective gains, all participants in the experimental group reported "feeling better" and felt that their physical activity had been the key to this. This was in agreement with almost all of the research done to date.

A decrease in depression with an increase in physical activity was demonstrated in this study. Certain other findings of this experiment such as a lowering of level of depression for both groups as measured by the SDS and the lack of fitness gain for either group as measured by the Step Test should be viewed with prudence. Caution must be used when interpreting these findings due to the lack of accurate pairing of experimental and control groups for sex, age, fitness level, etc., and also the volcanic interruption of the fitness program must be taken into account. The exact modality of this decrease in depression is not in the scope of this experiment. Theories explaining this increase are abundant. It might have been due to biochemical changes brought on by exercise (Sothmann and Ismail, 1984; Hull et. al., 1984; Sinyor and Schwartz, 1983; Schildkraut, 1984; etc.). It could be due to being "in control" as opposed to learned helplessness (Seligman, 1974). The freedom and renewed capacity to think creatively, by giving a depression-free interlude could renew hope that the illness itself would be time-limited (Greist et. al., 1979). A "competence motivation" that is, being able to successfully engage in a difficult task could lead to a depressed

person attempting other tasks and subsequently breaking the depressive spiral (Peoples, 1983). The built-in rewards, sense of accomplishment, improved self-esteem, increased working capacity, etc., could all play a role in reversing the depressive symptomology (Weltman and Stamford, 1983). Whatever the modality, the use of physical activity to combat depression was demonstrated in this study.

Physical fitness may not be the answer to problems of depression for everyone (Brown et. al., 1979; Hess, 1981; Blue, 1979; Fremont, 1984; Rueter, 1981; etc.). A combination of therapy and physical activity or therapy alone could be appropriate in some cases. But physical activity would probably be the easiest method to implement and also the least expensive.

The results of this study have potent theoretical implications. Depressive symptomology is related to both physical activity level and cognitive functioning. By increasing physical activity, the relief of depression is positively effected. Researchers in depression have long been aware of a tendency to non-action and lethargy of depressed people. Viewing the person in a holistic sense, we see the individual mind and body functioning as a unit and whatever affects one affects the other. So a beneficial interaction of physical activity and mental state could be a healthful result. A change in one system affects the other.

Future research on this topic could be improved in various ways. A better matching of experimental and control groups for age, sex, weight, level of activity, increasing the number of subjects, etc., with random assignments to groups could be used. The use of a

placebo treatment group (McCann, 1984) would help in justifying results. Reliability checks for physiological measures should be incorporated into the design of the experiment. The program could have several different groups of various activity levels to help assess just what level of activity is needed to significantly lower depression. The mental and physiological tests could be administered at closer intervals to help determine where and when the most significant changes took place. By fitting in more experimental controls, a study could be conducted that would have more power in testing the influence of physical activity on depression. This is an area of practical importance to researchers interested in the psychological well-being of a tremendous number of our society. It is also important to those people interested in taking a more controlling aspect in their own lives. Because of the interaction of the physical and the psychological portions of man the use of physical activity as preventive medicine for illnesses of both modalities is indicated. The use of physical activity as a treatment for depression has been supported but it may be more valuable as a prevention of the same disease.

APPENDIX A

INSTRUMENTS

Beck Depression Inventory

Name_____ Date_____

Directions: On this questionairre are groups of statements. Please read each group of statements carefully. Then pick out the one statement in each group which best describes the way you have been feeling the PAST WEEK, INCLUDING TODAY. Circle the number beside the statement you picked. If several statements in the group seem to apply equally well, circle each one. Be sure to read all the statements in each group before making your choice.

1. 0 I do not feel sad.
   1 I feel sad.
   2 I am sad all the time and I can't snap out of it.
   3 I am so sad or unhappy that I can't stand it.

2. 0 I am not particularly discouraged about the future.
   1 I feel discouraged about the future.
   2 I feel I have nothing to look forward to.
   3 I feel that the future is hopeless and that things cannot improve.

3. 0 I do not feel like a failure.
   1 I feel I have failed more than the average person.
   2 As I look back on my life, all I can see is a lot of failures.
   3 I feel I am a complete failure as a person.

4. 0 I get as much satisfaction out of things as I used to.
   1 I don't enjoy things the way I used to.
   2 I don't get real satisfaction out of anything anymore.
   3 I am dissatisfied or bored with everything.

5. 0 I don't feel particularly guilty.
   1 I feel guilty a good part of the time.
   2 I feel quite guilty most of the time.
   3 I feel guilty all of the time.

6. 0 I don't feel I am being punished.
   1 I feel I may be punished.
   2 I expect to be punished.
   3 I feel I am being punished.

7. 0 I don't feel disappointed in myself.
   1 I am disappointed in myself.
   2 I am disgusted with myself.
   3 I hate myself.

8. 0 I don't feel I am any worse than anybody else.
   1 I am critical of myself for my weaknesses or mistakes.
   2 I blame myself all of the time for my faults.
   3 I blame myself for everything bad that happens.

9. 0 I don't have any thoughts of killing myself.
1 I have thoughts of killing myself, but I would not carry them out.
2 I would like to kill myself.
3 I would kill myself if I had the chance.

10. 0 I don't cry any more than usual.
1 I cry more now than I used to.
2 I cry all the time now.
3 I used to be able to cry, but now I can't even though I want to.

11. 0 I am no more irritated now than I ever am.
1 I get annoyed or irritated more easily than I used to.
2 I feel irritated all the time now.
3 I don't get irritated at all by the things that used to irritate me.

12. 0 I have not lost interest in other people.
1 I am less interested in other people than I used to be.
2 I have lost most of my interest in other people.
3 I havelost all of my interest in other people.

13. 0 I make decisions about as well as I ever could.
1 I put off making decisions more than I used to.
2 I have greater difficulty in making decisions than before.
3 I can't make decisions at all anymore.

14. 0 I don't feel I look any worse than I used to.
1 I am worried that I am looking old or unattractive.
2 I feel that there are permanent changes in my appearance that make me look unattractive.
3 I believe that I look ugly.

15. 0 I can work about as well as before.
1 It takes an extra effort to get started at doing something.
2 I have to push myself very hard to do anything.
3 I can't do any work at all.

16 0 I can sleep as well as usual.
1 I don't sleep as well as I used to.
2 I wake up 1-2 hours earlier than usual and find it hard to get back to sleep.
3 I wake up several hours earlier than I used to and cannot get back to sleep.

17. 0 I don't get more tired than usual.
1 I get tired more easily that I used to.
2 I get tired from doing almost anything.
3 I am too tired to do anything.

18. 0 My appetite is no worse than usual.
1 My appetite is not as good as it used to be.

2 My appetite is much worse now.
3 I have no appetite at all anymore.

19. 0 I haven't lost much weight, if any, lately.
1 I have lost more than 5 pounds.
2 I have lost more than 10 pounds.
3 I have lost more than 15 pounds.

I am purposely trying to lose weight by eating less.
Yes_____ No_____

20. 0 I am no more worried about my health than usual.
1 I am worried about physical problems such as aches and pains; or upset stomach; or constipation.
2 I am very worried about physical problems and it's hard to think of much else.
3 I am so worried about my physical problems that I cannot think about anything else.

21. 0 I have not noticed any recent change in my interest in sex.
1 I am less interested in sex than I used to be.
2 I am much less interested in sex now.
3 I have lost interest in sex completely.

SCORING: The scoring is based on a 4 point scale for level of depression.

0 = None
1 = Mild
2 = Moderate
3 = Severe

From Beck, 1961

Physical Activity Index

Calculate your activity index by multiplying your score for each category.

(Score = Intensity x Duration x Frequency):

Intensity	5	Sustained heavy breathing and perspiration
	4	Intermittent heavy breathing and perspiration - as in tennis.
	3	Moderately heavy - as in recreational sports and cycling.
	2	Moderate - as in volleyball, softball.
	1	Light - as in fishing, walking.
Duration	4	Over 30 minutes
	3	20 to 30 minutes
	2	10 to 20 minutes
	1	Under 10 minutes
Frequency	5	Daily or almost daily
	4	3 to 5 times a week
	3	1 to 2 times a week
	2	Few times a month
	1	Less than once a month

Evaluation and Fitness Category

Score	Evaluation	Fitness Category
100	Very active lifestyle	High
60 to 80	Active and healthy	High
40 to 60	Acceptable (Could be better)	Medium
20 to 40	Not good enough	Low
Under 20	Sedentary	Low

From Sharkey, 1977

University of Montana
Missoula, Montana 59812
March 26, 1980

A 10-week program comparing fitness depression and self-concept.

You will be engaged in an exercise program three days a week for one hour per day lasting ten weeks. Exercising will consist of running, weight training, games, and other activities concentrating on aerobic fitness at the sub-maximal level. Certain tests of physical condition will be administered before and after the 10-week exercise program. Blood pressure, resting heart rate, body fat weight, and an estimation of the body's ability to use oxygen (step test), will be among the tests administered. Also, before and after the exercise program, two depression scales (Zung and Beck) and one self-concept scale (Tennessee) will be administered. The changes in all these measurements will be correlated after the program to see if any relationship exists.

The only discomforts that are anticipated are the same as those associated with any fitness or exercise program. You will be allowed to advance without any fear of adverse reactions to or from the program staff.

A gain in aerobic fitness and strength may be expected if you work at and participate in the program. These gains have been associated with a lower risk of coronary heart disease, lowering of blood pressure, lowering of body fat, gain in aerobic endurance, an improved self-concept, and a lowering of total anxiety. While associated, these relationships are not proven to be a cause and effect.

If further explanation of the program is wanted, please feel free to ask the instructor at any time. If you have any problems in types of exercises selected, suitable alternatives will be added, for example, the substitution of bicycling for running. All information given in the program will be kept in strict confidence and if you desire, you may have the information destroyed at the completion of the program. Thank you for your voluntary participation in this program.

Program Coordinators

Craig Montagne
Cathy Prinslow
Tom Cotner

I have read and understand the above and agree to participate in this program.

_____ Date_____
Signature

SELF-RATING DEPRESSION SCALE--ZUNG

	A Little of the time	Some of the time	Good Part of the time	Most of the time
1. I feel down-hearted and blue.				
2. Morning is when I feel the best.				
3. I have crying spells or feel like it.				
4. I have trouble sleeping at night.				
5. I eat as much as I used to.				
6. I still enjoy sex.				
7. I notice that I am losing weight.				
8. I have trouble with constipation.				
9. My heart beats faster than usual.				
10. I get tired for no reason.				
11. My mind is as clear as it used to be.				
12. I find it easy to do the things I used to.				
13. I am restless and can't keep still.				
14. I feel hopeful about the future.				
15. I am more irritable than usual.				
16. I find it easy to make decisions.				
17. I feel that I am useful and needed.				
18. My life is pretty full.				
19. I feel that others would be better off if I were dead.				
20. I still enjoy the things I used to do.				

The Self-Rating Depression Scale

SCORING: The scoring index is derived by dividing the sum of the raw score values obtained on the 20 items by the maximum possible score of 80, coverted to a decimal and multiplied by 100.

Norms: Scores 50+ suggest mild to moderate depression.
Scores 60+ suggest moderate to severe depression.
Scores 70+ suggest severe depression.

(Zung, W.K. A self-rating depression scale. Archives of General Psychiatry, 1965, 12 (1), 63-70.)

Adult Activity Fitness Log

Name _____

Date	Type of Exercise	(1) Duration	(2) Intensity	Date	Type of Exercise	(1) Duration	(2) Intensity

(1) Duration - When figuring the time spend engaging in an activity do not include the time when you are doing nothing or just standing around.

(2) Intensity - 5 - Sustained heavy breathing and perspiration - fast running.
4 - Intermittent heavy breathing and perspiration - tennis, raquet sports.
3 - Moderately heavy - cycling, soccer.
2 - Moderate - volleyball, softball.
1 - Light - fishing, walking.

APPENDIX B

RAW DATA

RAW DATA #1: EXPERIMENTAL GROUP

Subject #	Beck	Zung	Step	PAI	
01	23	62.5	22	32	Pre
	6	42.5	29	40	Post
02	25	68	43	20	Pre
	18	65	46	100	Post
03	1	32.5	42	8	Pre
	1	33.75	42	32	Post
04	9	38.75	39	24	Pre
	5	26.25	38	60	Post
05	10	46.25	22	12	Pre
	4	38.75	33	60	Post
06	5	57.5	36	30	Pre
	0	50	38	60	Post
07	5	45	39	6	Pre
	0	25	40	48	Post
08	5	41.25	39	45	Pre
	2	28.75	35	45	Post

RAW DATA #2: CONTROL GROUP

Subject #	Beck	Zung	Step	PAI	
09	5	46.25	49	48	Pre
	5	41.25	53	60	Post
10	8	50	42	32	Pre
	4	41.25	42	32	Post
11	2	30	49	64	Pre
	5	35	55	60	Post
12	14	52.5	42	48	Pre
	12	41.25	44	64	Post
13	1	43.75	61	48	Pre
	1	33.75	55	36	Post
14	2	30	39	8	Pre
	3	31.25	52	60	Post
15	2	48.75	40	32	Pre
	3	51.25	40	36	Post
16	2	40	38	24	Pre
	3	43.75	40	32	Post

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