TYPE A AND TYPE B FEMALE'S RESPONSE TO ACUTE EXERCISE: THE EFFECT OF STRESS REDUCTION

by

MARTHA JANE EBERT

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Chapter One

INTRODUCTION

In 1896, Sir William Osler, a physician, described the young coronary artery disease patients in his practice as robust, vigorous, and ambitious. A person "whose engine was always set full speed ahead" (Kaplan, 1982).

Doctors Meyer Friedman and Ray Rosenman, believed Sir Osler was describing the Type A behavior pattern. However, it was not until the 1950's that Friedman and Rosenman actually characterized the Type A behavior pattern. They identified common personality characteristics among the cardiac patients in their practice. In their own words, they defined "The Type A as one who is impatient, competitive, easily provoked, with an intense striving for achievement, exhibits time urgency and has abrupt gestures and speech", (Friedman, 1974).

Research was done to examine whether a relationship existed between personality type and coronary artery disease (Rosenman, 1964). From the western collaborative group study, Rosenman and Friedman found a significant relationship between heart disease and the Type A personality. As a result of their research, the Type A person was labeled the coronary prone individual. Rosenman and Friedman's findings stimulated much research in examining various components of the Type A and Type B personalities.

In a review of the research on personality types, Matthews (1981) found many significant differences in the way the two personality types respond to various life situations. The Type A person was consistently identified as the more aggressive, impatient, achievement-oriented person always striving to get ahead (Matthews, 1981). The Type B individual was found to be a more relaxed, easy-going person, with less demands.

While researchers continued to examine the components of the Type A and B behavior patterns, other investigators were examining the effects of exercise on blood pressure, anxiety and muscle tension or physiological stress in the body. It has been well documented by deVries, (1981) that exercise has a tranquilizing effect on muscle tension. His research has consistently shown that low intensity exercise reduced muscular tension as measured by electromyography (EMG).

Research has also examined whether exercise has an effect on state anxiety. State anxiety is a person's perception of their own anxiety at a specific moment in time. In a review of the research on the effects of exercise on state and trait anxiety, Dishman (1985) sites numerous studies where exercise has been found to reduce state anxiety as measured by psychological inventories.

Another area that has been closely examined is the effect of exercise on blood pressure (Tipton, 1984). However, the effects of exercise on blood pressure is less defined, as some research indicates that an acute bout of exercise lowers blood pressure following exercise and in other instances blood pressure showed no significant change (Denolin, 1977).

From the list of the studies reviewed for this investigation, it was evident that research on women's response to an acute bout of exercise was lacking. Twelve studies were reviewed regarding the effects of an acute bout of exercise on blood pressure, two limited its study to females, the other ten examined men only. From the studies examining the effects of exercise on anxiety, five studies investigated a mixed group of male and females, and eight studies used only males for their subjects. From the seven studies reviewed on exercise and EMG response, three studies used male subjects and four used a sampling of male and female subjects.

In spite of all the research on the Type A personality, state anxiety, stress, and blood pressure, the research that has examined whether Type A individuals respond differently to exercise than Type B individuals is limited. Would a more stressed or hurried individual, who may exhibit higher levels of state anxiety, increased muscle tension and higher blood pressure also have a greater relaxation response to exercise than the individual who is less tense?

Statement of the Problem

The purpose of this investigation was to examine whether blood pressure, state anxiety, and muscular tension (EMG) of Type A and Type B females responds differently to exercise. It was hypothesized that Type A females would have a greater reduction in resting blood pressure following acute exercise than Type B females, that the Type A female would have a greater reduction in electromyographic activity following an acute bout of exercise than the Type B female, and the Type A female's response to an acute bout of exercise relative to state anxiety would reflect a greater reduction in anxiety than the Type B female.

The study was delimited to examining the effects of one acute bout of exercise and one control session on blood pressure, EMG, and certain anxiety states of Type A and Type B females ages 18 to 40.

Limitations of the study involved using psychological measures to assess personality type and state anxiety. It was assumed that each individual's responses were honest and a true indication of their personality type and state anxiety.

Chapter 2

REVIEW OF THE LITERATURE

The chapter presents a review of the literature related to the physiological effects of exercise on muscle tension as measured by electromyography (EMG), blood pressure and psychological changes in anxiety due to exercise. Research findings relative to personality types, the effect of its response to exercise, and physiological differences in females will also be reviewed.

Physiological Effects of Exercise on Muscle Tension

Researchers have used electromyography (EMG), which is a record of electrical activity of a particular muscle, to observe changes in resting muscle activity following exercise. EMG is an electrical potential generated from the contraction of skeletal muscle fibers and is generally recorded in microvolt-seconds. The resting EMG measured from one muscle has been used by researchers as a predictor of the muscular tension level of the whole body.

Jacobson (1936) was one of the first who used EMG to measure muscle tension. He found athletes were better able to relax than non-athletes.

deVries (1968), in one of his earlier studies, measured the EMG from the right biceps brachii muscle. The EMG was measured before and after bench stepping for five minutes. The electrical activity had a mean decrease of 58% on the exercise day, but only 1.5% on the control day.

In a later study, again using the biceps muscle, deVries and Adams (1972) examined the responses of ten elderly subjects who considered themselves to have anxiety-tension problems. They walked at a speed to induce a heart rate of 100 bpm, for 15 minutes. Another day they walked at a speed to maintain a heart rate of 120 bpm for the same amount of time. Paired analysis showed that exercise lowered electrical activity by 20% at 30, 60, and 90 minutes after exercise. Exercise at 120 bpm approached but did not achieve statistical significance.

Sime (1977), used the frontalis muscle to measure EMG activity. He reported a decrease in EMG responses following 10 minutes of low intensity exercise on the treadmill in individuals who were assessed as trait anxious.

Conflicting reports by other investigators who have used the frontalis muscle to measure neuromuscular tension have questioned the tranquilizing effect of exercise. Farmer, Olevine, Cower, Edwards, Coleman, and Hames, (1978), reported no changes in EMG after a six minute submaximal bicycle ergometer test, and a six minute maximal work capacity test.

Nidever (1959), studied resting muscle tension in 23 muscles, the findings show that the frontalis muscle was one of the four muscles that did not appear to be an indicator of overall body tension at rest. The biceps brachii muscle scored the highest on the common tension factor at rest.

Physiological Effects of Exercise on Blood Pressure

Studies have examined acute exercise and blood pressure response. It has been found that systolic pressure rises at the beginning of exercise, continues to rise and plateaus. When systolic pressure declines the exertion can no longer be tolerated. (The drop in systolic pressure with continued increases in work load is a criterion for stopping the exercise testing.) The diastolic pressure has been found to stay about the same at the beginning of exercise and may slowly decrease as exercise continues.

Wilcox, Bennett, Brown, MacDonald (1982) examined 10 hypertensive men and 10 normotensive men. Each group exercised on the treadmill to induce a heart rate of 120 bpm for five 10 minutes periods separated by three minute rest periods. During the 30 minute rest periods after the tests, both groups showed a significant and sustained fall in systolic pressure below pre-exercise resting values. Mean standing blood pressures before exercise were 165/109 and 140/90 in the hypertensives and normotensives, respectively. Diastolic pressures were significantly lower in both groups five minutes after exercise, with mean values ranging from 83 to 87 mm Hg in the hypertensive groups, and 71 to 73 mm Hg in the controls. These values were taken in a supine position. When standing, diastolic pressure increased to above 100 mm Hg in four of the hypertensive patients but remained in the range of 86 to 96 mm Hg in the remaining six. Standing values for the normotensive were not given.

Fitzgerald (1981) when monitoring his own blood pressure before and after exercise, reported a substantial decrease in both systolic and diastolic pressure following exercise. He jogged 25 minutes at 70% of his maximum effort. His average blood pressure before exercise was 143/90 and after exercise was 122/74. He did not indicate how much time had elapsed after exercise when he measured his blood pressure nor did he mention whether he was in a standing or sitting position when the pressures were taken.

Hannun, and Kasch (1978) examined 10 normotensives and 13 hypertensive subjects. Each group exercised for two 40 minutes bouts, one continuously at 60% of VO_2 max and one intermittently alternating at 45% and 75% of VO_2 max. Blood pressures were monitored after each treatment for both groups during two hours after exercise. Significant results in the reduction of the mean systolic blood pressure were recorded in both groups. No significant changes in the mean diastolic blood pressure were reported for either group. After 100 minutes of recovery, blood pressures had returned to pre-exercise values for both groups.

Penny, Rust, Calton (1981) examined effects of jogging on resting blood pressure. Blood pressures were taken on individuals immediately after jogging and five minutes into recovery. Significant decreases were noted in blood pressure immediately after exercise and five minutes post exercise. No record of blood pressure past five minutes into recovery were made.

White, Yeater, Martin, Rosenberg, Sherwood, Weber, Della-qiustina (1984) examined the effects of aerobic dance on resting blood pressure. Post exercise blood pressure was measured 30 seconds after exercise, and after five minutes of recovery. Significant decreases were noted in the post exercise values when compared to the resting values before exercise. No record was made of blood pressure beyond five minutes into recovery.

Paulev, Jordal, Kristensen, Ladefoged (1984) examined the effects of an acute bout of exercise on 10 females with marginal hypertension, (an arterial blood pressure on some occasions equal to or above 160/95 mm Hg for either the systolic, diastolic or both values). Each subject exercised on a bicycle ergometer for 20 minutes at a load to induce a heart rate of 130 bpm. Arterial pressure was found to be significantly reduced for four hours post exercise ($p<0.05$). During the control trial, arterial pressure lowered below resting value after an hour of rest, but the reduction was not significant.

Hannum and Kasch (1981) conducted a study on 10 normotensives with a mean resting blood pressure of 128/80 and 13 borderline hypertensives with a mean pressure of 136/90. Each group exercised for 40 minutes at 60% of VO_2 max. Post exercise blood pressures were measured during a two hour recovery period. Blood groups exhibited mean pressures that were lower than their pre-exercise means. The hypertensive subjects were found to have a more pronounced reduction in systolic blood pressure after exercise than the normotensive subjects. The reduction lasted 90 minutes in the normotensive group and two hours in the hypertensive group. The average diastolic pressure although lower was not significantly effected by exercise in either group.

Psychological Changes in Anxiety Due to Exercise

Researchers have not only noted the positive physiological changes in individuals as a result of exercise, but also the positive psychological effects.

Cooper (1979), in his review of personality studies of athletes noted that athletes were consistently less anxious than non-athletes. Dishman (1985) reviewed experimental studies of both acute and chronic exercise. It has been consistently shown that a reduction in state (temporary or transient) anxiety occurred following exercise.

Schwartz (1978) noted that non-athletes who weekly averaged three hours of jogging for six months reported fewer symptoms of tension than did non-joggers who spent a comparable amount of time in meditation.

Wood (1977) divided male runners into two groups, those who were considered to have high levels of anxiety and those with low levels of anxiety. Significant reductions in state anxiety occurred following exercise in the highly anxious runners, but anxiety increased significantly after exercise in the group who considered themselves to be less anxious.

Morgan and Horstman (1976) examined males and females for state anxiety changes before and after exercise. Each individual exercised for twenty minutes at 80% of VO_2 max. Anxiety was significantly decreased immediately following exercise and went below baseline level ten minutes into recovery.

In another study, eighteen women and eighteen men were tested by Morgan, Roberts and Feinerman (1971) for levels of anxiety and depression. Students were randomly assigned to either a one mile treadmill walk (17 min) at 3.5 mph and 0 grade, a 3.5 mph treadmill walk at 5% grade for 17 minutes, or the control treatment which consisted of 17 minutes of supine rest. The Anxiety Battery and the Depression Adjective Check List were completed immediately following the various treatments. No significant differences were found and the investigators concluded that physical activity did not effect anxiety or depression.

Bahrke and Morgan (1978) compared an exercise group, a non-cultic meditation group, and a control group for state anxiety. The State Trait Anxiety Inventory was given to 75 men before and twenty minutes following three treatments which were: treadmill exercise at 70% of maximum oxygen consumption, meditation using Benson's relaxation response, and control (which involved sitting quietly). All three groups showed significant reduction in state anxiety. The authors suggested that it was not the physiological changes but the "time out" or diversional aspects of the activity that lowered anxiety.

Sime (1977) examined the effects of exercise, meditation or placebo on test anxiety of 48 students. Exercise treatments involved treadmill exercise which induced a heart rate of 100 to 110 bpm for 10 minutes with 5 minutes of recovery. Meditation consisted of listening to Benson's relaxation techniques for 15 minutes, and a placebo pill reported to be either a tranquilizer or a sugar pill. State anxiety was markedly lower though not significant for the exercise and meditation group.

Differences in Type A and Type B Personalities

The Type A personality was identified by Meyer Friedman (1974) after observations he made of the behaviors of cardiac patients in his private practice in the 1950's.

He noted that Type A individuals had similar characteristics such as sitting on edge of a chair, pacing, and eating hurriedly. It seemed to him that Type A individuals were more tense or stressed than other patients (later referred to as the Type B personality) in his practice. As the Type A personality became identified as "the coronary prone personality" (Friedman, 1974), much research has been done to more clearly understand the Type A individual (Matthews, 1982).

Matthews (1978) reports that Type A subjects speak louder than Type B subjects. Carver and Glass (1978) report that Type A subjects outperform Type B subjects in difficult situations that call for persistence or endurance, and "B"s report fatigue sooner than "A"s.

Gastorf (1980) examined 240 psychology students with definite A or B characteristics. As part of the experiment, the students were instructed to arrive by a certain time to complete a particular inventory. It was found that Type A individuals arrived consistently earlier for the testing than the Type B individual.

Glass, Synder, Hollis (1974) report that Type B subjects outperform Type A subjects on tasks that require slow, careful responses. This poor performance of "A"s on tasks that require slow work has been interpreted as consistent with the time urgency and impatience of the Type A personality (Matthews, 1982).

Van Egeren (1979) showed that "A"s engage in aggressive behavior more often than "B"s and that "A"s play a role in eliciting aggressive behavior from others. Kahn (1980) in his review of studies on blood pressure measurements during bypass surgery found that "A"s had a greater elevation in blood pressure than "B"s. Carver (1976) reported that Type A men put greater effort into doing well on a strenuous physical task. They report less fatigue than Type B men.

Contrada (1979) reviewed 14 studies on personality type and physiological changes which occurred in response to specific environmental events. Ten out of the 14 studies showed that Type A males exhibited greater elevations in resting blood pressure, plasma epinephrine and sometimes heart rate response than Type B males. It has also been reported that Type A individuals walk faster and often sit on the edges of their chairs (Gastorf, 1980).

Personality Type and Their Response to Exercise

Sime and Parker (1978) examined whether Type A and Type B individuals differ in their physiological arousal to exercise. Subjects were told to come to the experimental trial and be prepared to exercise on a treadmill. No differences were found between the groups in heart rate, blood pressure, and EMG after instructions and demonstrations were given on the treadmill. The study did not require the subjects to exercise.

Farmer (1978) measured EMG activity from the frontalis muscle of six Type A and eight Type B individuals. At rest, the groups did not differ in muscle tension as measured by EMG. No differences in EMG activity was observed following six minutes of sub-maximal bicycle ergometer test or after a six minute maximal work capacity test.

Ratings of perceived exertion were monitored in response to exercise by Ross, Morgan, Leventhal (1978) in Type A subjects and Type B subjects. Individuals were exercised on the treadmill until maximal capacity was reached. No differences were found between the two groups during exercise.

Olewine, Thomas, Simpson, Ramsey, Clark, Hames (1974) studied the response of plasma and urinary catecholamine in Type A subjects and Type B subjects following exercise. He found no differences in plasma epinepherine and norepinepherine between the two groups during exercise. It was found that Type "A"s have higher levels of norepinepherine at rest and during recovery.

Physiological Differences in Females

Much of the research reviewed on the effects of exercise on blood pressure, EMG activity and anxiety has been done on male subjects, or mixed groups. Few researchers have investigated whether females respond to exercise in a similar manner as males. Although much research has examined the physiological differences and similarities between males and females (Wells, 1985). Women have been found to have smaller hearts than males of the same age, making their stroke volume less than men. The heart rates of females have been found to be higher at rest and during exercise than males when exercising at the same intensity (Wells, 1985).

Men have been found to have 6% more red blood cells and 10-15% more hemoglobin per 100 ml of blood than women. As a result, for any given level of oxygen uptake or metabolic activity, women must deliver more blood to the tissues in order to supply the same quantity of oxygen or extract a greater quantity of oxygen from the blood provided (deVries, 1980). Due to the smaller body size in females, total lung capacity (residual volume and vital capacity) is less than in males (Comroe, 1962).

Women have been found to have a greater percent of body fat, less muscle tissue and a lower ratio of strength to weight when compared to men (Wells, 1985). Metabolic rate has been found to be lower in females, largely due to decreased lean body weight and increased adipose tissue. The greater lean body mass in males is due not to the differences in fiber type but in size of the various fibers (Prince, Hikida & Hagerman, 1977).

It is clear that physiological differences between males and females exist, and no studies were identified that indicate a female's blood pressure and EMG response would be different from a male's response to exercise. However, establishing that females do respond in a similar fashion as males to exercise would increase the strength and the value of the findings already in the literature on EMG and blood pressure response that have been done predominantly on male subjects.

Summary

The studies on Type A subjects' and Type B subjects' response to exercise are limited. Clearly, whether differences exist in the two groups has not been adequately examined. We know that differences exist in their responses to life situations but we do not know if each responds to exercise differently. More specifically, we need to understand the nature of the exercise effect on their muscular tension and stress level. In the one study that examined differences in EMG responses of Type A and Type B individuals, the frontalis muscle was used to take the measurement. As previously indicated, the frontalis muscle has been shown to be a poor indicator of overall muscle tension (Nidever 1959).

It seems reasonable that a more tense or hurried individual may exhibit different blood pressure measurements, different feelings of anxiety, and different levels of muscle tension, which would be reflected on the psychological inventories and physiological measurement of

EMG than a calm, less tense individual. As exercise has been found to have a tranquilizing effect on anxiety and muscle tension, it is possible the differences may exist in the Type A and B individuals after exercise. The following study was designed to examine closely whether differences do exist in Type A and Type B females responses to exercise.

CHAPTER 3

PROCEDURES

This chapter will discuss subject selection, preliminary measurements, experimental design, data collection and statistical analyses.

Selection of Subjects

To obtain an appropriate sampling of Type A and Type B females, subjects were selected from staff members at St. Mary's Hospital, and various students and faculty members from Kansas State University. Interested female subjects were screened using the Jenkins Activity Survey (JAS) to assess their personality type (Jenkins, Zyzanski & Rosenman 1979). Questionnaire scores ranged from 0 to 100, with those scoring 0 to 50 considered as Type B and those scoring from 50 to 100 considered Type A. In this study, individuals selected to be Type A subjects scored 65 or above with a mean score of 84.0, S.D. of 9. Individuals selected to be Type B subjects scored 40 or below with a mean score of 28.1, S.D. of 13.7 (Appendix A).

Twenty-one women, aged 18 to 43, with a mean age of 30, were chosen for the Type A and B groups, with eleven making up the Type A group and 10 for the Type B group. All were healthy individuals with no known medical problems that limited their participation in the study. Participants 35 and over were asked to obtain a physician's approval before beginning the study. Each subject was fully informed of the testing procedures and had signed an informed consent before beginning the study (Appendix B).

Preliminary Measurements

The preliminary measurements consisted of determination maximum oxygen consumption, and baseline elctromography. Each will be discussed as a separate unit.

Determination of maximum oxygen consumption (VO_2 max):

A graded exercise test was administered to all participants to determine their maximal oxygen consumption and maximal heart rates. After an initial warm-up at 3 mph and 0% grade, the test protocol continued in two minute stages at 4% grade. The grade remained unchanged throughout the test. Treadmill speed started at 3 mph and was increased 1 mph for each succeeding stage until the subject's VO_2 max was obtained. Heart rate was monitored continuously with a Hewlett Packard-1500 B electrocardiograph and a hardcopy of the recorded heart rate was made at the end of each stage.

Oxygen consumption was measured at the second minute of each stage, and was determined using an open circuit technique. Subjects were fitted with a Daniels breathing valve attached to a 4.0 l mixing chamber through a 45 cm (35 mm diameter) flexible hose. The volume of expired air (V_E) was measured continuously using an Alpha Technologies Ventilation Meter. The electrical signal was displayed on a digital meter and records of the ventilation were obtained at appropriate intervals. A continuous gas sample of 500 ml per minute was drawn from the mixing chamber and passed in series through anhydrous $CaSo_4$ in a 25-ml drying tube for gas analysis. Expired air samples were analyzed for oxygen and carbon dioxide content with Beckman OM-11 and LB-2 analyzers, which were calibrated before and after each measurement period using a certified gas mixture. The analog output of the gas analyzers was channeled through A/D converters which allowed the precise recording of the rapid fluctuations in gas concentration on digital counters. Setting the counters on 30-s mode (gate time) provided 2 integrated and discrete values for Feo_2 and $Feco_2$ per minute. The data were recorded manually and minute oxygen consumptions were calculated and expressed in standard units (liter/min, STPD).

VO_2 max was reached when each individual`s maximal predicted heart rate (220-age) was within range and the subjects indicated by pre-designated signals to the investigators that they could no longer tolerate the work load.

A linear regression was then established between oxygen consumption and heart rate. From the linear regression, work and heart rates were determined corresponding to 60% of each subject's maximum oxygen consumption, to establish each individual's exercise prescription.

Electromyography:

The resting integrated electromyogram (iEMG) was monitored using a bi-polar surface electrode system placed on the biceps brachii and attached to hi-gain amplifiers. The two active electrodes for the bi-polar electrode system, consisted of two infant EKG cup electrodes mounted on plexiglass two inches apart insuring a constant distance between electrodes. Participants gently flexed the biceps muscle of their left arm and the electrodes were placed on the belly of the muscle along the longitudinal axis. The ground electrode was placed on the ventral aspect of the left wrist. The electrode sites were abraded to produce an interelectrode resistance of less than 5000 ohms and usually less than 2-3000 ohms.

During the resting iEMG measurement, subjects rested in a supine position on a reclining lawn chair which was placed in a 6 x 9 foot structure covered with copper panels. The copper panels acted as a barrier screening electrical interference (noise) from other sources in the laboratory. Each subject was allowed to position the chair in such a manner as to enhance their relaxation. As subjects relaxed, the muscle electrical potentials were monitored at 10 second intervals over a 5 to 8 minute period.

iEMG activity was measured on a Coulbourn high gain bioamplifier with the gain set at 10,000 X (X represents times) and the time constant at 10 volt seconds. The output was subsequently channeled through a digital converter and displayed on a read-out meter giving integrated (iEMG) over consecutive ten second periods. The displayed iEMG values were recorded throughout and the lowest 10 values were averaged and used for the criterion measure in microvolt seconds (divided by 10 seconds).

Before the experimental trials began, all subjects visited the laboratory and a baseline iEMG measurement was made to allow each subject to familiarize themselves with the measurement of iEMG (Appendix A).

Throughout the relaxation interval, subjects listened to a pre-recorded instructional and music tape to uniformly enhance their ability to relax as they attempted to achieve total relaxation. The relaxation tape used baroque music in the background with the superimposed investigator's voice directing the relaxation technique (Tauraso 1979).

Each subject listened to the same tape during the preliminary measurement of iEMG and during the experiemental and control trials of the experiment.

Experimental Design

The experimental design consisted of one exercise and one control treatment. During the exercise treatment subjects walked or jogged on the treadmill, for twenty minutes at a 4% grade at varying speeds which maintained them as close as possible to the heart rate corresponding to 60% of their maximum oxygen consumption.

The control treatment consisted of sitting quietly for twenty minutes. Each individual acted as her own control and remained in the laboratory the same amount of time as during the exercise trial.

The order in which the control and exercise treatments were completed was randomized. Participants were informed of which treatment they would accomplish only after they had completed the psychological inventories and the physiological measurements were obtained during the pre-test period. Psychological and physiological data collection preceded and followed each exercise or control sessions in identical fashion.

Data Collection

The three variables, blood pressure, EMG and state anxiety collected during the experimental and control trials will be discussed independently.

Blood Pressure Measurements:

During each experimental trial the subject's blood pressure was measured three times in the 10 minute period before iEMG measurement. The mean of the three blood pressure measurements were used as the baseline resting pressure for that day. Once the twenty minute treatment interval was started, whether it was the exercise or control session, blood pressures were taken every five minutes.

Following the treatment interval, whether it was the exercise or control session, blood pressure measurements were made very ten minutes for one hour. Blood pressure readings were taken with an upright mercury sphygmomanometer, on the subject's left arm. Subjects were in a standing position during all blood pressure measurements.

Electromyography:

iEMG measurements were taken 10 minutes prior to the experimental treatments, after completing the psychological inventories, and ten minutes following the experimental trials upon completion of the psychological inventories.

After the iEMG measurement was completed, the subjects were ready to begin the treatment intervals of twenty minutes of exercise or twenty minutes of sitting quietly. Throughout the exercise treatment, the subjects' heart rates were monitored electrocardiographically. Following a brief warmup and after subjects had reached their pre-determined heart rate, the twenty minute exercise interval was started. The heart rate was recorded every minute and the speed of the treadmill adjusted to maintain the desired heart rate.

To verify intensity of exercise (60% VO_2 max), each subject's oxygen consumption was measured at the 10th and the 20th minute of exercise. A five minute cool down followed the exercise interval before post-exercise testing continued.

Psychological Measurements:

Psychological inventories designed to measure state anxiety were completed before the pre-treatment iEMG measurement prior to experimental trials, and after the experimental treatment preceding the post-exercise iEMG measurement.

The psychological inventories, Profile of Mood States, (POMS) a modified Autonomic Perception Questionnaire (APQ) and Speilberger's Inventory for State-Trait Anxiety (STAI) were used to assess anxiety states. The POMS consists of 65 questions that identify and rate six mood states (McNair, Lorr & Droppleman 1971). The APQ was comprised of 20 questions concerning physiological changes due to anxiety (Mandler, Mandler, Uviller, 1958, Feltz, 1983). The STAI consists of 20 questions that ask individuals to rate how they feel at a particular moment in time (Spielberger, Gorsuch, Lushene, 1975).

Statistical Analysis

Analysis of covariance was used to analyze the data for differences in post session scores where personality types and treatments (exercise and control) were the main effects. Pre-session scores of the dependent variables were used as co-variates. Both main effects and interactions were evaluated at the $p<0.05$ level of significance.

Chapter 4

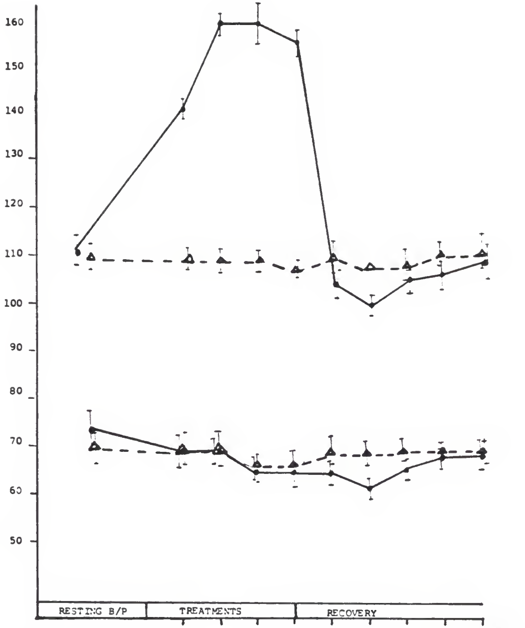
RESULTS

The results of each variable investigated, blood pressure, EMG and psychological responses will be presented independently. Descriptive data of individual subjects are located in Appendix C and D.

Blood Pressure

Mean systolic and diastolic blood pressures before and after the exercise and control sessions of Type A subjects' are illustrated in Figure 1, and the Type B subjects' mean systolic and diastolic pressures before and after the treatment sessions are illustrated in Figure 2.

The mean resting systolic and diastolic blood pressure of the Type A subjects was 111/72 with a S.D. of 9.2 (systolic) and 6.0 (diastolic) and that of the Type B subjects was 108/71 with a S.D. of 11.4 (systolic) and 5.6 (diastolic). At twenty minutes post-exercise the Type A subjects' mean resting blood pressure, was 100/61 and at ten minutes post exercise the mean resting blood pressure for the Type B subjects' was 98/62. The reductions in mean resting blood pressure that occurred in both personality types 10 to 20 minutes post exercise were statistically significant at the 0.05 level. Analysis of covariance showed that the Type B subjects' lowest blood pressure



		5	10	15	20	10	20	30	40	60 min.
● Exercise Session	111/72	140/70	160/70	160/66	156/66	104/66	*100/61	105/65	106/69	108/69
△ Control	110/70	110/70	110/70	110/68	108/68	110/70	108/70	108/70	110/70	110/70

Figure 1 Mean blood pressures before and after exercise and control sessions of Type A subjects.
*Significant reduction at the 0.01 level.

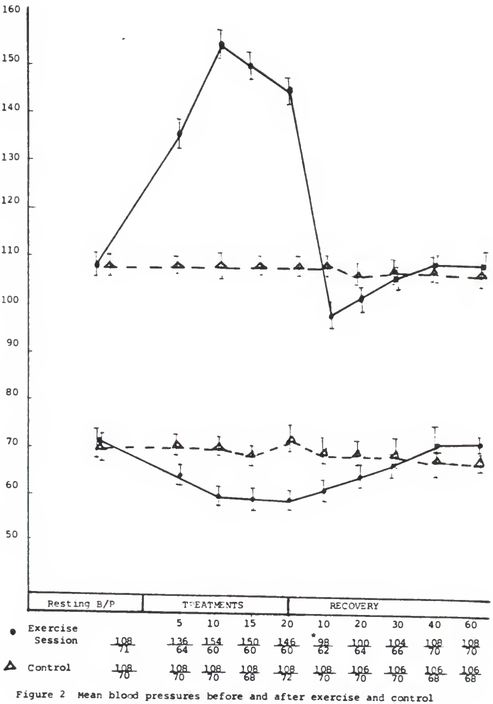


Figure 2 Mean blood pressures before and after exercise and control sessions of Type B subjects.
*Significant reduction at 0.01 level

reduction occurred 3 to 4 minutes earlier than Type A subjects, and this difference was statistically significant at the 0.05 level.

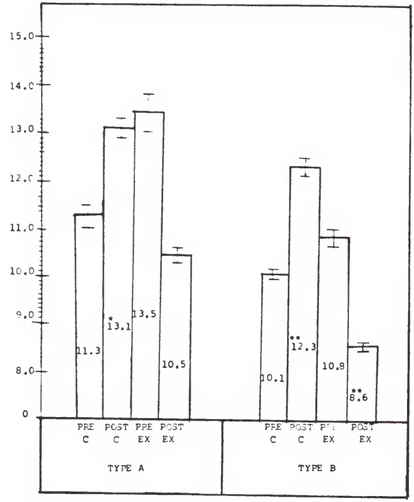
At one hour post-exercise, the Type A subjects' mean resting blood pressure of 108/69 was slightly lower than the pre-exercise resting value but was not significantly different. The Type B subjects' mean resting blood pressure 108/70 had returned to the resting values by 40 minutes post exercise. As would be expected, mean blood pressures did not change significantly during the control sessions.

The mean reduction in systolic pressure among all subjects was 8.2 mmHg while the mean diastolic blood pressure was reduced 8.6 mmHg. This reduction was significant ($p<0.01$) at the 10 to 20 minute interval following exercise. Analysis of covariance indicated no significant differences between Type A and B subjects in the amount of the blood pressure reduction.

Electromyography

Figure 3 illustrates mean EMG response to both the control and exercise sessions. Type A subjects' mean EMG was reduced by 3.0 microvolts (S.D. of 5.1) after exercise and increased a mean of 1.7 microvolts (S.D. of 1.2) following the control trial of sitting quietly. The increase in mean EMG after the control session in Type A subjects was significant at the 0.01 level. Although a

Figure 3 Mean values of EMG response between types before and after control and exercise session, in microvolts per 10 seconds.
* indicates significant change in EMG (p 0.01)
** indicates significant change in EMG (p 0.05)



reduction did occur in the mean EMG of Type A subjects after the exercise session, it was not significant at the 0.05 level. However, when the data of one subject who exhibited exceptionally high EMG values was removed, variation about the mean EMG value was reduced and a significant reduction ($p<0.01$) EMG was observed for the Type A group.

The mean EMG of Type B subjects increased 2.2 microvolts (S.D. of 1.7) following the control trial, while the mean EMG value was reduced after the exercise session by 2.1 microvolts (S.D. 0.69). The changes in mean EMG in Type B subjects were significant at the 0.05 level.

The mean change of EMG for all subjects regardless of personality type after the exercise session was significantly different ($p<0.01$) than mean change in EMG following control session.

The reduction in EMG following exercise was not significantly different between Type A and Type B subjects when classified according to the JAS as previously described.

However, then groups were reclassified based on EMG scores, (EMG) 10 as Group A and EMG (10 as Group B) postexercise mean EMG values were significantly different between Type A and Type B subjects at the 0.01 level.

Psychological Responses

The mean scores of the Type A and Type B subjects' psychological responses before and after the exercise and control session are illustrated in Appendix C. Mean differences in psychological parameters between pre and post session scores of Type A and B personality types during exercise and control sessions are shown in Table 1.

From the Profile of Mood States (POMS), six mood states were examined: tension, depression, anger, vigor, fatigue and confusion. Spielberger's inventory (A-State) was used to measure state anxiety and the autonomic perception questionnaire (APQ) examined physiological changes due to anxiety as perceived by the subjects before and after the experimental trials.

As measured by POMS inventory, no differences were observed by analysis of covariance in the subject's perception of their tension post exercise or control for either personality type or treatment. The interaction of type and treatment did produce significant differences ($p<0.01$) in the mean post session tension scores. In Type A subjects, perception of tension was more effected by exercise than in Type B subjects. The mean reduction between pre and post session tension scores after the exercise session was 9.6 units in Type A individuals and 3.7 units for Type B subjects, (Table 1). Following the control trial, tension scores were reduced a mean of 3.8

Table 1 Mean changes between pre and post values of personality types at exercise and control sessions. (negative numbers indicate reduction)

	Type A		Type B	
	Exercise	Control	Exercise	Control
*Tension	-9.6	-3.8	-3.7	-6.6
Depression	-2.9	-1.5	-1.7	0.4
Anger	-5.0	-3.0	-2.6	-2.1
**Vigor	1.5	-3.8	2.3	-0.1
Fatique	-4.5	-3.0	-3.4	-2.0
Confusion	-6.5	-2.4	0.3	-1.8
A-State	-10.2	0.1	-6.0	-4.6
*APQ	1.3	-10.1	-10.8	-0.8

* indicates significant difference between exercise and control across personality types ($p < 0.01$)

** indicates significant differences between exercise and control ($p < 0.05$)

units in Type A subjects and 6.6 in Type B subjects. A Duncan's test of the means showed the Type A score after exercise was significantly different than the other post mean scores.

No significant differences were found in perception of either depression or anger between types, treatment or type by treatment interaction. The subjects' perception of their fatigue and confusion showed no significant differences between personality type, treatment or interaction of personality type by treatment.

Mean post session vigor scores were not significantly different by type or type by treatment interaction. Significant differences ($p<0.05$) were observed in perception of post-session vigor, however, depending on the treatment. For Type A subjects, perception of vigor increased a mean of 1.5 units after exercise while Type B subjects' perception of vigor increased a mean of 2.3 units after exercise. Type A subjects' mean vigor scores were decreased 3.8 units following the control session while that of Type B subjects' decreased by 0.1 units.

No significant differences were observed in Spielberger's state anxiety inventory by personality type, treatment, or the type by treatment interaction. The APQ inventory showed significant differences in type by treatment interaction at the 0.05 level, but no differences were observed between personality type or treatments.

The APQ responses indicated that Type A subjects sensed more anxiety-induced physiological changes after the exercise trial than after the control trial. Type A subject's APQ score increased a mean of 1.8 units after exercise but decreased a mean of 10.1 units after the control trial. Type B subjects also indicated a greater reduction in their perception of anxiety-induced physiological changes after the control trial, (mean of 6.6 units) than after the exercise session (mean of 3.7 units). A Duncan's test of the means showed the Type A subject's post exercise APQ score to be significantly different than the other means.

Summary of Results

In summary, blood pressure was temorarily reduced following exercise in both personality types (significant at 0.05 level) but returned to pre-exercise values within one hour. A reduction occurred in EMG following exercise in both groups, however only the Type B subjects' reduction was statistically significant. EMG increased significantly following the control session for both personality types. Anxiety states showed minimal change following the exercise or the control sessions. No differences were observed between personality types and their response to exercise.

Chapter 5

DISCUSSION

The changes observed in the variables investigated, blood pressure, EMG, and anxiety states will be discussed separately.

Blood Pressure Responses

The results of this study indicated that 20 minutes of exercise at an intensity of 60% of maximum oxygen consumption caused a temporary reduction in systolic and diastolic blood pressure in both Type A and Type B females. This temporary reduction occurred during the 10 to 20 minutes interval post exercise. As blood pressure was not altered during the control trials, it can be concluded that the temporary reduction in blood pressure was due to the 20 minutes of low intensity exercise.

The findings support the work of Hannun and Kasch (1978), Penny et. al. (1981), White et. al. (1984), Paulev et al. (1984), and Wilcox et. al. (1982) who also showed that blood pressure was temporarily reduced following exercise. Hannun and Kasch (1981) reported a temporary reduction in blood pressure following an acute bout of exercise for 40 minutes at 60% of VO_2 max. However, blood pressure was reduced for a longer period of time, from 9 to 100 minutes in normotensives and 7 to 120 minutes post exercise in hypertensives, than in the present study. The differences in the length of the reductions may be due to the greater mean resting pressures before exercise in hypertensives. In the present study the mean blood pressure was 110/70 in Type B subjects and 118/74 in Tape A subjects.

Paulev et. al. (1984) reported significant reduction ($p<0.05$) in resting blood pressure for 4 hours following a 20 minutes exercise treatment on a bicycle ergometer in ten females with borderline hypertension. Total peripheral resistance (TPR) was measured and also showed a significant reduction ($p<0.05$) following exercise. The authors suggested this decrease in TPR partially explained the reduction in blood pressure observed in their subjects following exercise. The present study did not show the prolonged reduction in resting blood pressure as observed in Paulev's study. Subjects who exhibited this prolonged reduction in resting blood pressure in Paulev's study were borderline hypertensive, with a mean blood pressure of 160/95, the mean resting pressure for the present study in Type A subjects was 118/74 and in Type B subjects was 110/70. Again the differences in the duration of the reduction following exercise may be due to the greater mean resting blood pressure before exercise.

Wilcox et. al. (1982) reported a significant reduction ($p<0.001$) in resting systolic blood pressures in hypertensives, (mean resting value of 165/109) and in his control group, (mean resting value 140/90) following five, 10 minute exercise intervals, separated by three minute rest periods. Post-exercise resting blood pressures were significantly reduced for thirty minutes. Again the mean resting value was much higher than the mean resting value of the present study.

Penny, et. al. (1981) also reported a significant reduction in resting blood pressures of male faculty members following a two mile run, (mean resting blood pressure value was 132/82). Blood pressures were taken only once, five minutes into recovery, and the reduction was significant at the $p<0.01$ level. The findings of the present investigation support Penny's findings that acute exercise causes a temporary reduction in blood pressure.

The mechanisms which cause this temporary reduction in blood pressure are not well understood. Hannun and Kasch (1981) suggested the reduction in blood pressure following exercise may be due to thermoregulation, decreased vascular resistance, decreased blood volume, sodium reduction or an increased vascular bed. It is easily recognized that a combination of these factors may contribute to the temporary reduction in blood pressure following exercise.

Edington and Edgerton (1976) related that exercise in man causes vasodilation, which acts to lower blood pressure. Abboud (1974) found that the increase in blood flow from exercise reduced peripheral vascular resistance and blood pressure. Sundsfjord, Stromme & Aakvaag (1975) reported that exercise caused a reduction of aldosterone along with a lowering of sodium which, in turn, lowered blood pressure. Abboud (1974) stated that sodium reduction alters aldosterone, lowers norepinephrine and may alter vascular tone, all three of which can reduce blood pressure. Kirsch, Risch, Mund, Rocker & Stoboy (1975) established that exercise resulted in a loss of blood volume and an increase in the vascular bed size. Kjellmer (1965) found that exercise increased the vascular bed in part by capillary vasodilatation.

The present study supports the findings of the previous researchers who have suggested that a period of moderate aerobic exercise may result in significant reduction in post-exercise blood pressures. However, personality type did not effect one's blood pressure response to exercise, but females' blood pressure following an acute bout of exercise responded similarly to males' blood pressure as reported in previous studies.

Electromyography (EMG)

This study demonstrated that an acute bout of exercise at an intensity equivalent to 60% of maximum oxygen consumption for 20 minutes significantly reduced the EMG of Type B females as compared to the control treatment of quiet sitting. A reduction in mean EMG did occur in Type A subjects but was not significant at the 0.05 level. There was evidence, however, to suggest that this result may have been an artifact of this experiment. When one Type A subject, (Subject 34, Appendix A) whose pre-session EMG values were nearly twice the group means was removed from consideration, the reduction in the mean EMG scores of Type A females was significant at the 0.01 level, mean reduction of 1.53 with S.D. of 0.69, (at the time of the testing, subject 34 was experiencing intense emotional trauma).

Significant changes did occur in the mean EMG of both Type A and Type B subjects during the control trial, indicating that sitting for twenty minutes under experimental conditions caused both Type A and Type B subjects' EMG to increase significantly ($p<0.01$). However, the findings of the present investigation are in agreement with the results reported by deVries, et. al. (1968) who demonstrated a reduction in EMG at an exercise intensity of 40% for 20 minutes duration. The magnitude of reduction in the present study was similar to the reduction in EMG as reported by deVries. deVries reported a reduction in tension of 25% after exercise and an increase of 24% following the control trial. Tension of the Type A individuals in the present study decreased 29% after the exercise session and increased 17% following the control session. The Type B subject's tension was decreased 27% following exercise and increased 23% after the control trial.

In a later study, deVries & Adams (1972) compared the effect of moderately intense exercise, low intensity exercise, the tranquilizing drug meprobamate, and a placebo on the muscular tension level of highly anxious individuals. The differences between treatments were highly significant ($p<0.001$). EMG was significantly reduced following the low intensity exercise, but the EMG reduction following the moderately intense workload did not reach statistical significance. Meprobamate and placebo conditions did not differ from the control treatment.

The findings of the present study also support the work of deVries, Wiswell, Bulbulian & Moritani (1981). Muscular tension of high anxious subjects were evaluated before and ten minutes after 20 minutes of moderate bicycle ergometer exercise and a control session. EMG activity decreased significantly after exercise in comparison to the control condition. These findings also agree with McGlynn (1978) who reported significant increases in EMG activity following a control session of resting for twenty minutes.

The mechanism which allows individuals to relax after exercise is not completely understood. Experimental work on cats (deVries 1981), indicated that an increase in the temperature of the brain stem or the body results in decreased muscle spindle activity amd synchronized electrical activity in the cortex of the brain, which are both typical of a more relaxed state. He suggested that "because exercise in humans raises body temperature, a tranquilizing effect may result from exercise".

Haugen, Dixon & Dickel (1960) suggested that "random and intermittent constantly changing proprioceptive stimuli would allow for normal cortical activity but a persistent bombardment of excessively strong stimuli from chronic bracing of all striated musculature would result in overactivity of the arousal area and generate apprehension, fear and similar phenomena in the cortex". deVries concluded "that low intensity exercise brings about a random, intermittent, constantly changing proprioceptive stimulus that is believed to be necessary for normal cortical functioning and therefore a more relaxed state".

The findings of the present study support deVries conclusions that a tranquilizing effect occurs in individuals following an acute bout of low intensity exercise. However no significant differences were observed between the two personality types in the amount of EMG increase during the control trials, or the amount of EMG reduction following exercise.

To more clearly examine whether differences exist between Type A and Type B subjects' response to exercise, the subjects were classified according to their baseline EMG, (EMG $>$ 10 = Group A, EMG $<$ 10 = Group B), and significant differences were evident between the two groups in their mean EMG response to exercise ($p<0.01$).

The use of EMG to physiologically assess personality type has not been investigated. It has been previously documented that an increased amount of emotional stress results in increased EMG activity (Lundevold 1952, Newman 1953, & Jacobson 1936). It has also been suggested by deVries (1972) that "EMG may be the most objective measurement available to assess anxiety tension states".

The Type A personality has been defined by several researchers, Friedman (1972), Rosenman (1966), & Jenkins (1975). It is a behavior pattern that is "characterized by extremes of competitiveness, aggressiveness, haste, impatience, restlessness, tenseness of facial muscles and feelings of being under pressure" (Jenkins 1975). These characteristics certainly suggest that the Type A individual is experiencing increased stress and anxiety. Therefore, if EMG can appropriately assess anxiety and muscle tension, is it possible to use EMG to assess the Type A personality which is characterized by high levels of anxiety? Not according to Mihevic (1982) who argues that "anxiety states are affective states rather than personality traits".

In the present study the Jenkins Activity Survey was used to classify personality types, however, there has been some question as to whether JAS is an appropriate tool to assess personality types. Matthews' (1982) review of the literature on the Type A personality suggests that a majority of the questions on the JAS deal with competitiveness and the "striving-to-achieve" aspect of the Type A individual and too few questions are directed toward the emotional states such as anger, hostility and anxiety which are important components of the Type A individual. Clearly more research is needed to establish whether EMG is an appropriate discriminator of an individual's personality type.

Psychological Responses

Exercising for 20 minutes at an intensity of 60% of maximal oxygen consumption had minimal effect on the various anxiety states as measured by the Profile of Mood States, Spielberger's Anxiety Inventory (A-State) and the Autonomic Perception Questionnaire in this study. There were changes in the various mood states, as measured by POMS but few were significant. Tension was shown, by two-way analysis of variance, to be significantly affected ($p<.05$) by the kind of treatment within each personality type. The greatest mean reduction following exercise in Type A subjects occurred in tension and A-State (Table 1), suggesting that tension and A-State were measuring similar components of anxiety. ($r=.86$)

Tension and A-State were reduced in Type B subjects as well. However, the control session produced a greater reduction in tension than the exercise session. A-State was reduced more after exercise than after the control trial, but the decrease was not statistically significant.

These findings agree with those of Sime (1977), who found measureable, but not significant, decreases in A-State following an acute bout of exercise ten minutes of exercise at a heart rate of 100-110 bpm). The present study also agreed with Morgan et.al. (1971), who found no significant changes in anxiety and depression following an exercise session or a control session of resting quietly. These investigators also found no differences between males or females in the manner with which they responded. The findings of the present study do not support Morgan and Horstman (1976) who reported significant reductions in state anxiety immediately following an acute exercise bout for twenty minutes at 80% of maximum oxygen consumption. It appears that reduction in mood states may be dependent on intensity of exercise.

The findings of Bulbulian & Darabos (In Press) and Andres, Metz, & Drash (1978) provide additional evidence that exercise intensity is a factor in the reduction of anxiety. Bulbulian & Darabos reported a significant reduction in the Hoffman reflex (a method used to assess central nervous system excitability) following exercise at 40% and 75% of maximal oxygen consumption. However, the reduction following 75% intensity was 21.5% compared to 12.8% at 40% intensity of exercise. Andres et. al. (1978)

reported a significant reduction in state anxiety following twenty minutes of treadmill exercise at 70% of maximum heart rate.

In the present study, Type A subjects showed a greater reduction in tension after exercise but Type B subjects showed a greater reduction in tension after the control trial, supporting Rosenman's (1978) findings that Type A individuals become more restless than Type B individuals while waiting.

Both personality types reported an increase in vigor following exercise, though the differences were not statistically significant. This agrees with Kowal (1978) who also reported an increase (not statistically significant) in females following exercise. Kowal (1978) assessed changes in anxiety mood states in males and females using the Profile of Mood States following exercise training. He reported a reduction in the same variables as the present study. The reduction in the male subjects' mood states was statistically significant, but that of females was not, which parallels the present data regarding females.

Mean scores of the various other mood states decreased following the control trial as well as the exercise trial, (Table 1). Similar findings were reported by Barke et. al. (1978), who found that a significant reduction occurred in A-State following an exercise session at 70% of $\dot{V}O_2$ max for twenty minutes, mediation session and distracted rest session. Barke, et. al. suggested that it was the "time out" that allowed subjects to relax, rather than the treatment. Possibly exercise intensity is not responsible for the reduction in anxiety following a work-out, but rather the diversion. The findings of the present investigation support this conclusion although it has been contradicted by others (Mihevic, 1982, Bulbulian & Darbos, In Press, Morgan & Horstman, 1976).

The APQ questionnaire showed a greater reduction in the perception of anxiety-induced physiological changes after the control trial in Type A subjects (10.1 units) but the greater mean reduction in Type B subjects occurred after the exercise trials (10.8 units), Table 1. It appeared, however, that many subjects had difficulty interpreting the questionnaire after the exercise session. The APQ questionnaire contains items pertaining to changes in breathing, changes in heart rate, or increased perspiration, all of which are indicative of increased anxiety, but also occur normally after an acute bout of exercise. Therefore, in the present study, the APQ questionnaire appeared to be an inappropriate tool with which to assess physiological changes due to anxiety immediately after exercise.

Reasons for changes in various mood states following exercise vary. Folkins (1972) suggested that reduced electrical activity in muscles occurring after increased physical fitness may be cognitively perceived as an indication of reduced anxiety. Merzbacher (1979) concludes that increased oxygenation of blood circulating to the brain might enhance cerebral function, causing an individual to feel less anxious. Cantor (1978) postulated that increased capillarization and oxygen consumption is the basis for psychological benefits of exercise. Seley (1974) stated that "physical activity can help one relax and withstand mental frustration more effectively by the mobilization of useful adaptive reactions and an increase in general resistance to strong stressors".

As indicated, the effect of exercise on the various mood states has been contradictory. Mihevic (1982), in her review of the literature suggested that light exercise is not effective in modifying state anxiety. In a later review of the literature Dishman (1985), also suggested "that high intensity exercise (70% VO_2 max or greater) for at least 20 minutes is needed to insure an acute reduction in state anxiety, and a positive effect on anxiety is less reliable at moderate intensities of exercise". The findings in the present study support their conclusions.

Although reductions in anxiety did occur, it may be argued that subjects who scored within the normal range on the various mood states would not be expected to experience significant reductions in anxiety following exercise. It is also possible that the psychometric instruments used were not sensitive enough to appropriately assess changes in mood states, given the variability among subjects. For example, the mean coefficient of variability about the post-exercise mood states means was 36.01 suggesting that the large amount of variability obscured differences between types and between treatments. It may also be necessary to increase sample size to effectively detect a difference in mood states as affected by personality type and treatment.

Conclusion

In conclusion, the results of the present study support previous findings that exercise at an intensity of 60% of maximal oxygen consumption for twenty minutes decreases muscle tension as measured by EMG, and temporarily lowers blood pressure, but does not support the popular belief that acute physical activity improves psychological states.

The findings did not support the hypothesis that Type A individuals would have different responses to exercise than the Type B individuals. However, when all individuals were grouped according to their baseline EMG, significant differences were evident between the groups in exercise-induced resting EMG activity.

Recommendations

This study did not find differences in Type A and Type B subjects' response to exercise. Additional research is necessary in the area of personality type and response to exercise. It is recommended that additional classification tools be used to assess personality type when selecting subjects for the Type A and Type B behavior patterns. Certainly more research is necessary to determine whether EMG may be an appropriate discriminator of personality type.

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APPENDIX A

JAS scores, baseline EMG, and pre and post session values of EMG in Type A and Type B subjects.

TYPE A SUBJECTS

Subject	JAS	baseline EMG	control pre	control post	exercise pre	exercise post
30	75	10.5	8.4	9.6	9.3	8.3
31	90	12.5	8.4	9.4	12.8	9.9
32	99	11.1	8.5	9.6	11.4	10.1
33	85	10.6	13.0	13.5	13.3	11.5
*34	85	12.0	23.4	24.5	38.2	19.7
35	90	12.2	11.9	15.5	11.7	10.6
36	85	12.5	10.7	11.3	12.3	10.3
37	65	9.5	9.9	13.5	9.8	9.3
38	80	8.3	7.9	11.3	10.8	9.1
39	80	12.2	12.5	14.7	10.6	9.1
40	90	9.3	9.8	11.2	8.7	8.2
means		10.9	11.3	13.1	13.5	10.5

TYPE B SUBJECTS

Subject	JAS	baseline EMG	control pre	control post	exercise pre	exercise post
10	35	16.9	12.2	18.1	15.6	10.6
11	40	8.1	11.6	12.4	7.9	7.1
12	30	8.2	7.7	10.4	11.4	9.6
13	35	11.0	11.3	14.3	13.2	9.1
14	35	9.0	9.0	13.2	8.2	7.9
15	40	9.2	9.4	11.0	9.2	7.3
16	3	8.0	7.8	8.5	12.7	7.1
17	30	7.9	11.6	12.5	10.5	9.3
18	3	9.2	8.8	9.3	9.5	7.5
19	30	10.4	11.3	13.4	11.4	11.3
means		9.7	10.0	12.3	10.9	8.6

APPENDIX B

TYPE A AND TYPE B RESPONSES TO EXERCISE

Informed Consent

I, ________________________ voluntarily consent to participate in a study that examines Type A and Type B personalities responses to exercise. Responses that will be measured are blood pressure, muscle tension and anxiety level. Before participating in the study, I will be assessed as to what my personality type is, and I will be screened to establish my suitability for the study.

As part of the study includes exercising at 60% of my heart rate range for 20 minutes, I will first be administered a graded exercise test to determine my maximal heart rate and maximal oxygen consumption. The graded exercise test measures maximum exercise capacity and consists of steadily increasing levels of work performed on a treadmill. The workload starts very light and progresses to complete fatigue. The effort required is comparable to running a half mile race with maximal effort required only during the last 60 seconds. I am free to terminate the effort at any time. The test will be terminated by the experimenter if any of the following symptoms of stress occur: excessive breathlessness, nausea, facial pallor (loss of color), clamminess and pain.

During the experimental trial, before exercising begins, I will complete an anxiety level inventory, my blood pressure will be taken at least 3 times, approximately 5 minutes apart to determine my baseline pressure, a resting surface electromyography (EMG) will be measured to determine baseline muscle tension.

I will then exercise on the treadmill for twenty minutes at 60% of my heart rate range. My B/P will be monitored every 5 minutes during exercise and every 10 minutes postexercise. EMG will be assessed immediately after exercise to determine how exercise affects my "stress" level. I will also complete an anxiety inventory immediately after exercise.

1) The risks of the graded exercise test in healthy subjects are minimal, however, breathlessness, muscle soreness, and in rare instances, heart rate irregularities or heart attack may occur. The discomforts from participating in the experiment include moderate fatigue, muscle soreness and increased perspiration.

(continued)

2) The benefits of participation will include knowledge of results of my personality type, my maximal heart rate, maximal consumption and how my B/P responds to exercise. I will also learn how exercise affects my "stress level".

3) I understand that in the event of physical injury resulting from the research procedure involved in this experiment, no financial compensation will be available since the regulations of the state prohibit Kansas State University from carrying insurance for such purposes.

4) I understand that if I have any questions regarding my participation in this study or about the nature of this study, I may contact the project director, Dr. Ron Bulbulian (532-6765) or Marty Ebert (539-2446).

5) I also understand that I am free to withdraw my consent and participation in the study at any time without prejudice to me.

6) I am assured that all aspects and results of the testing will remain confidential. If the results are prepared for publication, no participants will be identified by name. Results of the study will be made available to me at my request from either of the two mentioned experimentors.

Signature ________________________ Date______________

APPENDIX C

Type A subjects' descriptive data, exercise prescription, % VO_2 achieved during 10th and 20th minute of exercise.

subject	age	wt. lbs	max (l/m) VO_2	Exercise Rx 60% max VO_2 corresponding VO_2	HR
30	30	155	3.09	1.85	127
31	25	115	3.09	1.85	160
32	24	108	2.24	1.53	153
33	38	133	2.53	1.52	148
34	28	133	2.61	1.56	131
35	36	105	2.10	1.26	144
36	21	122	3.40	2.04	154
37	27	155	3.10	1.86	153
38	35	130	3.10	1.86	171
39	31	142	2.37	1.42	153
40	35	120	2.65	1.59	132

	10th min XCS			20th min XCS		
	HR	VO_2	% VO_2 max	HR	VO_2	% VO_2 max
30	130	1.62	53	127	1.56	52
31	164	2.06	67	150	1.35	68
32	154	1.35	60	144	1.53	60
33	144	1.53	60	148	1.66	65
34	130	1.41	54	136	1.57	60
35	144	1.22	58	146	1.25	60
36	150	2.14	63	158	2.37	69
37	150	1.82	59	150	1.96	63
38	168	1.77	57	175	1.83	59
39	150	1.46	62	150	1.52	65
40	136	1.82	68	135	1.86	69
mean % max VO_2 achieved during exercise trial			60			62

APPENDIX D

Type B Subject's Descriptive data, Exercise Prescription, % VO_2 achieved during 10th and 20th minute of exercise.

Subject	Age	wt. lbs.	max (1/m) VO_2	Exercise Rx 60% max VO_2 corresponding VO_2	HR
10	18	125	3.39	2.03	112
11	30	149	1.94	1.16	142
12	28	115	2.15	1.29	148
13	28	134	2.88	1.73	160
14	43	114	1.93	1.15	152
15	38	132	1.71	1.02	125
16	29	133	2.31	1.38	163
17	24	140	2.76	1.65	147
18	27	145	2.96	1.77	177
29	27	135	1.86	1.11	131

	10th min XCS			20th min XCS		
	HR	VO_2	% VO_2 max	HR	VO_2	% VO_2 max
10	110	1.42	42	116	1.60	47
11	140	1.17	60	144	1.24	64
12	145	.85	40	150	1.21	57
13	156	1.63	59	164	1.77	62
14	156	1.26	65	150	1.20	62
15	122	1.08	63	126	1.18	69
16	160	1.45	63	164	1.53	66
17	150	1.73	63	147	1.91	69
18	172	1.52	52	175	1.70	58
19	130	.94	50	135	1.25	67
mean % of max VO_2 achieved during exercise trial			56			62

APPENDIX E

Type A

	PRE C	±SD	POST C	±SD	PRE EX	± SD	POST EX	±SD
Tension	48.0	11.7	44.2	9.6	53.4	13.3	43.8	10.6
Depression	48.7	16.1	47.2	14.2	49.5	14.0	46.6	11.7
Anger	51.0	14.4	48.0	14.0	55.2	10.9	49.7	12.0
Vigor	53.4	8.4	49.6	9.7	50.7	12.0	52.1	10.3
Fatigue	46.0	8.2	43.0	5.6	48.3	7.9	43.9	8.3
Confusion	45.4	10.5	43.0	8.6	50.8	11.4	44.3	10.3
A-State	36.6	12.5	36.7	13.2	47.4	16.3	37.2	16.0
APQ	27.5	21.0	17.4	13.0	25.6	15.3	26.9	21.7

Type B

Tension	46.2	10.4	39.6	9.2	49.8	10.6	46.1	10.2
Depression	42.1	8.1	42.5	8.1	47.7	9.9	46.0	10.2
Anger	47.1	13.1	45.0	12.2	52.2	15.7	49.6	14.2
Vigor	48.0	9.5	47.9	10.3	49.0	7.1	51.3	10.3
Fatigue	47.3	8.4	45.3	11.2	51.5	11.3	48.1	7.5
Confusion	42.6	7.6	40.8	6.6	46.3	8.4	46.6	9.0
A-State	36.6	11.8	32.0	15.5	36.5	12.8	30.5	7.9
APQ	16.7	20.1	15.9	21.1	29.2	40.7	18.4	26.3

Type A and Type B Subject's mean psychological responses and standard deviations (± SD), before and after the control and exercise sessions.

TYPE A AND TYPE B FEMALE'S RESPONSE TO ACUTE EXERCISE: THE EFFECT OF STRESS REDUCTION

by

MARTHA JANE EBERT

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Acute and chronic exercise reduces muscle tension and blood pressure while causing a tranquilizing effect in man. The effects of exercise on Type A (coronary prone) and Type B (coronary resistant) individuals are not established and little data on its effect in women is available. This study was conducted to examine these areas of deficiency in the literature. Twenty-one female subjects were recruited from a larger group of candidates who were administered the Jenkins Activity Survey (JAS). Subjects with JAS scores above 65 were designated Type A and those with scores below 40 were labeled Type B. Resting integrated electromography (iEMG), blood pressure (BP) and psychometric measures were taken before and after a twenty minute exercise bout at 60% VO max, and a control non-exercise resting session in each of the two groups. Analysis of co-variance showed a significant reduction ($p<0.05$) in post-exercise iEMG (mean iEMG reduction in Type A 1.5, S.D. of 0.7 and Type B 2.1, S.D. of 1.8, and a significant reduction in BP (mean BP reduction in Type A 111/72, S.D. of 9.2/6.0 and in Type B 108/71, S.D. of 11.4/5.6). However the differences between Type A and Type B subjects were not significant. Ten psychometric variables showed little response to acute exercise with the expection of tension reduction in Type A ($p<0.01$) and an increase in vigor in both groups ($p<0.05$).

When the data were reanalyzed with Type A and Type B designations determined by the highest (Type A) and the lowest (Type B) iEMG values, a very strong personality type difference surfaced ($p<0.01$) with the Type A subjects showing greater reductions in iEMG subsequent to exercise. These findings suggest that psychometric measures may not be sufficiently sensitive to properly determine Type A and Type B groups of subjects in small samples. In general the exercise response of BP and iEMG in women was consistent with the findings in men. Finally, no differences in BP and iEMG response to acute exercise were apparent between the Type A or Type B individual when grouped according to the JAS.