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# A Controlled Comparison of Aerobic Exercise and Behavioral Treatment for Recurrent Tension Headache

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# A CONTROLLED COMPARISON OF AEROBIC EXERCISE AND BEHAVIORAL TREATMENT FOR RECURRENT TENSION HEADACHE

by

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This dissertation, submitted by Marty Paul Witucki in partial fulfillment of the requirements for the Degree of Doctor of Philosophy from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done and is hereby approved.

(Chairperson)

This dissertation meets the standards for appearance, conforms to the style and format requirements of the Graduate School of the University of North Dakota and is hereby approved.

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## ABSTRACT

Tension headache is a widespread problem, with an estimated lifetime prevalence rate of 69% for males and 88% for females. Empirical evidence supports the clinical observation that daily stress is a powerful precipitant of tension headaches. Research also supports the contention that tension headache sufferers tend to appraise and cope with daily stressors in ways which exacerbate or prolong this stress. Because aerobic exercise (EX) has been implicated as a useful stress relieving agent, this study examined the use of aerobic exercise as a treatment for tension headache. A comparison treatment consisting of progressive relaxation, stress management, and biofeedback (PR), was used because of its effectiveness in treating tension headache. A total of eighteen subjects were randomly assigned to either treatment and participated in an eight week treatment. Four weeks prior to treatment, subjects monitored headache activity, and completed three questionnaires (State-Trait Personality Inventory-Trait scale, Orientation to Life Questionnaire, and Headache Locus of Control-Revised scale). Subjects monitored headache activity throughout treatment and four weeks posttreatment. The questionnaires were also completed by subjects immediately after completing treatment. Subjects in the EX treatment group also completed these

questionnaires midway through treatment to determine the effectiveness of treatment at that point.

ANOVAs were used to compare the dependent measures between and within groups. Although trends toward improvements in average headache intensity and peak headache intensity emerged for both groups, they were not significant. It was also found that neither group showed significant improvements on dimensions measured by the questionnaires, with the exception of the curiosity dimension on the Trait State Personality Inventory-Trait scale and the health professionals externality dimension of the Headache Locus of Control-Revised scale. On these dimensions, those in the EX treatment group scored significantly lower than those in the PR treatment group across pre and posttreatment. When treatment groups were combined, peak headache intensity scores were significantly lower at posttreatment than at pretreatment. The lack of significant findings for both groups were likely due to small sample size; therefore, it is difficult to conclude whether or not aerobic exercise is an effective treatment for tension headache.

# CHAPTER I

# INTRODUCTION

Headache is a widespread problem. Among the general population, studies have found that 15-30% of women and 7.5-15% of men are affected by headaches often severe enough to affect daily activities (Blanchard & Andrasik, 1985). Leviton (1978) reported that approximately 7% of outpatient medical visits are related to headache complaints. Tension headaches are the most common type of headache. The estimated lifetime prevalence rate for tension headaches is 69% for males and 88% for females. Of those who experience tension headaches, 6.1% of males and 14.0% females have four or more headaches per month (Linet, Stewart, Celentano, Ziegler, & Sprecher, 1989).

Headaches also have a costly economic impact on both individuals who suffer from recurrent headaches and society as a whole. Blanchard and Andrasik (1985) collected data on patients seeking help for headache and found that in the two years prior to seeking medical help they spent an average of $955 for headache relief. Also, Holroyd, Holm, and Penzien (1988) reported that in the United States recurrent headache accounted for approximately 65 million lost work days per year. Many tension headache sufferers require at least intermittent medical treatment for their pain. This complaint accounts for a significant proportion of office visits to physicians as an estimated 15% of males and 28% of females have consulted a physician for headache pain (Stewart, Celentano, & Linet, 1989). One of the reasons headache is such a costly disorder is that standard medical interventions are generally aimed at alleviating pain rather than addressing the causes of headaches. Therefore, treatment for headache generally consists of continuous attempts to control the symptoms and accompanying distress. Although behavioral treatments attempt to address causes of headaches more directly, such as muscular tension, than do medical interventions, some individuals report little if any relief with techniques such as relaxation or biofeedback. In addition, behavioral treatments can be costly as they usually require, at least initially, extensive professional contact and consultation.

The above information clearly indicates that recurrent headache affects a substantial portion of the population and represents a difficult and costly problem. Therefore, research exploring new treatments which prove to be effective and cost efficient can be important.

## Descriptions of Tension Headache

Historically, descriptions of tension headache have been vague and even contradictory. These headaches have been described as a bilateral tightness of the head or bandlike sensation which becomes caplike in distribution, with a viselike ache (Diamond & Dalessio, 1982). Descriptions have stated that these sensations occur frequently in the forehead and temple or in the back of the head and neck, as well as in other cephalic regions. It has been suggested that tension headaches may be unilateral in nature, but are usually bilateral and may involve the temporal, occipital, parietal, or frontal regions singularly or in any combination. Finally, although descriptions of tension headaches usually indicate that they are brief, nonlocalized, and can drastically change in their frequency and intensity over a brief period of time, it has also been claimed that they may localize in one area and sustain with varying intensity for weeks, months, and even years (Diamond & Dalessio, 1982). This clearly indicates that our understanding of tension headaches has been far from precise. In practice, tension headache is often diagnosed when the patient's headache symptoms do not seem to include migrainous features and do not result from allergies, sinus problems, or symptoms of an organic disease (Holroyd, 1986).

The International Headache Society (1988) has recently attempted to clarify descriptions of tension headache by preparing diagnostic criteria for the disorder. They have identified two subtypes of tension headache: episodic tension headache and chronic tension headache. Episodic tension headache is defined as follows:

> Recurrent episodes of headache lasting minutes to days. The pain is typically pressing/tightening in quality, of mild or moderate intensity, bilateral in location and does not worsen with routine physical activity. Nausea is absent, but photophobia or phonophobia may be present (p. 29).

Chronic tension-type headache is defined as follows:

> Headache present for at least 15 days a month during at least 6

months. The headache is usually pressing/tightening in quality, mild or moderate in severity, bilateral and does not worsen with routine physical activity. Nausea, photophobia or phonophobia may occur (p. 31).

Pathophysiology of Tension Headache

Tension headache is usually attributed to "sustained contraction of skeletal muscles in the absence of permanent structural change, usually as a part of the individual's reaction during life stress" (Ad Hoc Committee on Classification of Headache, 1962, p. 718). The pain of tension headache is thought to be the result of stimulation of pain receptors in the contracted muscles and ischemia, which is the result of compression of intramuscular arterioles (Haynes, 1980).

Since it is generally believed that tension headache results from sustained muscle contraction, it would seem to make sense that increased muscle activity (electromyographic recording, EMG) would differentiate those who suffer from tension headaches from individuals who are headache-free. However, research pertaining to the physiological etiology of tension headache has yielded inconclusive results.

Chapman (1986) reviewed 28 studies comparing frontalis EMG activity of tension headache sufferers and headache-free controls and found only nine studies in which tension headache sufferers had significantly elevated EMG recordings. Six studies found inconclusive results and 13 studies found no significant differences between the frontalis EMG activity of tension headache sufferers and that of headache-free controls.

Of the six studies which found inconclusive results, three revealed a trend for those subjects with tension headaches to have higher resting frontalis EMG than controls, but the trend was non-significant. One study showed that psychiatric patients with tension headaches had higher EMG levels than non-patient controls but not non-headache psychiatric patients. One study showed higher frontalis EMG activity in a tension headache group subsequent to a relaxation period compared to headache-free controls, but this result was not observed after a the subjects were instructed to sit quietly. Finally, one study revealed significantly higher EMG activity in the right, but not in the left frontalis in a headache group composed of tension, migraine, and mixed headache sufferers as compared to headache-free controls.

The nine studies which showed significant differences in frontalis EMG activity were older studies with considerable errors in methodology and poor experimental control. A number of errors were noted including, a lack of time allowed for subjects to habituate to the experimental situation, the current headache state of the subjects were not considered prior to measurement of EMG activity, and the determination of drug treatment by headache sufferers was not considered. Further, groups were not matched on age or gender of the subjects (Chapman, 1986).

To explain these conflicting results, Philips (1977) suggests that muscle activity is typically viewed as a tonic dysfunction when instead it should be viewed as a phasic response to environmental stress. Philips' model argues that headache and nonheadache groups may not differ on measures of muscle contraction at rest, but may instead differ in response to environmental stress. Research investigating this model has neither confirmed nor rejected this hypothesis. A number of studies have supported this model (Cohen, Williamson, Monguillot, Hutchinson, Gottliob, & Waters, 1982; Philips & Hunter, 1982; Van Boxtel & Van der Ven, 1978; Vaughn, Pall, & Haynes, 1977), while others have not reported results consistent with this model (Anderson & Franks, 1981; Andrasik & Holroyd, 1980; Gannon, Haynes, Safrenek, & Hamilton, 1981; Martin & Mathews, 1978).

It has also been hypothesized that increased muscle tension levels may be a result and not a cause of tension headache (Raskin & Appenzeller, 1980). Therefore, the pain state of the subject during assessment of muscle tension may need to be taken into account when comparing the physiological responses of tension headache sufferers to headache free controls (Chapman, 1986; Hursey, Holroyd, Penzien, & Holm, 1985). Hursey et al. (1985) examined the forehead muscle tension of chronic-tension-headache subjects compared to headache-free control subjects during a laboratory stress procedure. Analysis of forehead muscle reactivity between these two groups showed equivocal results. Further analyses, in which tension headache sufferers were divided into those experiencing and those not experiencing headache at the time of assessment, did show significantly more forehead muscle activity in those subjects experiencing headaches than in those not experiencing headache or in headache-free controls. Muscle reactivity of tension headache sufferers not experiencing headache at the time of assessment was not found to be significantly different from headache-free control subjects.

Vascular factors have also been considered in the etiology of tension headache. Results from some studies indicate that localized cephalic vasodilation may accompany tension headaches (Haynes, Gannon, Cuevas, Heiser, Hamilton, & Katranides, 1983; Martin & Mathews, 1978). However, other studies have reported that tension headaches tend to be associated with localized cephalic vasoconstriction (Bakal & Kaganov, 1977; Wolff, 1963). Differences in the methodology of these studies makes it difficult to reconcile the different findings and indicates a need for further research.

In sum, although research is equivocal, it appears that physiological components exists with tension headache. The difficulty, however, continues to be discovering if a cause and effect relationship exists between these components and tension headache and the direction of this relationship. It seems that further research is necessary to sort out this difficulty. However, it appears that more recent investigations have emphasized that, if present, physiological differences between tension headache sufferers and controls may only emerge during periods of responsivity to life stress.

<u>Stress and Tension Headache</u>

It has often been assumed and accepted that tension headaches can be the result of life stress (Ad Hoc Committee on Classification of

Headache, 1962). Research investigating the relationship between life stress and tension headache has consistently found that the frequency of stressful life events (e.g., death of spouse, divorce) is not significantly greater for recurrent tension headache sufferers than for headache-free controls (Andrasik, Blanchard, Arena, Teders, Teevan, & Rodichok, 1982; Andrasik & Holroyd, 1980; Holm, Holroyd, Hursey, & Penzien, 1986). Holm et al. (1986) found, however, that tension headache sufferers did report more everyday stresses (e.g., traffic jams, deadlines at work) prior to assessment than did headache-free controls. Holm et al. (1986) compared responses of tension headache sufferers on the Hassles Scale (Kanner, Coyne, Schaefer, & Lazarus, 1981) to responses of headache-free controls; results revealed that tension headache sufferers reported a mean of eight more hassles over the previous month than did headache-free controls. Furthermore, Holm et al. (1986) reported that tension headache sufferers were more likely to appraise and cope with potentially stressful events in ways likely to exacerbate and prolong the stress (e.g., avoidance; self-blame).

Further empirical support for a stress-headache connection comes from Gannon, Haynes, Cuevas, and Chavez (1987) who showed that headache could be induced in a laboratory by a cognitive stressor. The stressor consisted of arithmetic problems presented every 15 seconds for an hour. Subjects were told that if their performance fell below a set point a buzzer would go off. The buzzer was presented throughout the session a predetermined number of times. Results showed that the procedure produced an activation of the cardiovascular and skeletal musculature systems indicating that the procedure could be considered a psychophysiological stressor. Of all the subject groups (tension headache, migraine headache, and headache-free), the tension headache group showed the highest mean heart rate. In tension headache subjects who experienced a headache during the procedure, a near significant increase in heart rate was found as compared to controls. Furthermore, the procedure elicited headaches in most of the headache sufferers and in a small percentage of the headache-free controls. In sum, empirical evidence supports the clinical observation (Friedman, 1979; Howarth, 1965) that stress is a frequent and powerful precipitant of tension headache.

Medical Treatment of Tension Headache

Analgesics are commonly used to alleviate the pain of tension headaches. Analgesics range from mild preparations such as aspirin to more potent prescription drugs (e.g., narcotics such as codeine). Prescription and nonprescription analgesics usually take the form of APC or APC-like drugs. An APC drug contains aspirin in combination with phenacetin and caffeine. Prescription medications generally add a narcotic, sedative, or hypnotic component to the APC combination. Acetaminophen is also found in some nonprescription APC-like drugs, while propoxyphene is a common additional ingredient in prescription APC-like drugs. Different analgesic medications have not been differentially effective in alleviating tension headache and in some cases are no more effective than placebos (Evans, 1974). In addition, critics of pharmacological interventions have suggested that analgesic medication is an inappropriate method of treating frequent headaches because of potential for addiction (psychological and sometimes physiological), decreased cognitive and motor performance, and paradoxical headaches. Daily use of high levels of analgesics have been shown to cause a condition known as paradoxical headache in which the medications come to exacerbate the headache activity (Rapoport, Sheftell, Baskin, & Weeks, 1984).

Behavioral/Psychological Treatment of Tension Headache

Because of the relative ineffectiveness of medications for treating recurrent tension headache, a number of behavioral treatments have been developed. The treatments tend to fall into one of three categories: a) relaxation training, b) biofeedback training, and c) combined biofeedback and relaxation training (Holroyd, Holm, & Penzien, 1988).

Relaxation Training. Relaxation training is intended to give headache sufferers the ability to gain control of physiological responses thought to be related to their headaches (e.g., sympathetic nervous system arousal). It is further intended to allow headache sufferers to cope with stresses they encounter in their daily lives as it provides a "time out" from these stresses. Finally, some suggest it has a multitude of nonspecific effects such as improving self-esteem by providing headache sufferers with something they have control over and can use to master or combat their headaches.

Three types of relaxation techniques have been used to treat headaches: a) autogenic training--this uses self-statements of feelings of warmth and heaviness to achieve the relaxation; b) progressive relaxation--this technique utilizes tensing and relaxing alternating muscle groups of the body to achieve a state of relaxation; and c) passive relaxation--which includes the use of medication. A recent meta-analysis of behavioral treatments for tension headache found that relaxation training for 15 groups yielded an average group improvement of 44.6% in headache activity and an average subject improvement of 37.9%, with a range of improvement of 17% to 94% (Holroyd & Penzien, 1986). Improvement scores were based on responses obtained on the headache index which measures the daily intensity and duration of a headache. The improvement measure was obtained by determining the difference between pretreatment and posttreatment headache index scores and this was divided by the pretreatment score and this was multiplied by 100.

Biofeedback Training. Biofeedback training allows a person to become aware of some particular physiological activity that is generally out of conscious awareness and control. This new awareness is intended to be used by the individual to gain some amount of control over the physiological activity being monitored. Electromyographic (EMG) biofeedback is used to give tension headache sufferers information about muscle tension levels of the scalp and neck. This is intended to enable tension headache sufferers to develop an awareness and control of excessive contraction of scalp and neck musculature presumed to cause headache. It also may reduce facial muscle tension which is hypothesized to promote generalized relaxation and also may be associated with a reduction in sympathetic activity (Stoyva & Budzynski, 1974). A recent meta-analysis of the use of EMG biofeedback for the treatment of tension headache found that for 26 groups examined there was an average group improvement of 46%, and an average subject improvement of 43.5% with a range of improvement of 13% to 87%. Improvements were based on measures obtained from headache diaries which measured the average headache activity per week (Holroyd & Penzien, 1986).

Combined Biofeedback and Relaxation Training. Biofeedback and relaxation can be, and often are, combined in the treatment of tension headache. The most popular combination in the treatment of tension headache is EMG biofeedback and progressive relaxation training. The reason for the combination is that each component might complement the other and result in a synergistic treatment effect. A recent meta-analysis of combined biofeedback and relaxation training found that for nine groups examined, there was an average group improvement of 57.1%, and an average individual improvement of 55.9% with a range of improvement of from 29% to 88%. The measure examined was the average headache intensity per week (Holroyd & Penzien, 1986).

In the meta-analysis conducted by Holroyd and Penzien (1986), all behavioral interventions (relaxation training, biofeedback training, and combined biofeedback and relaxation training) were more effective than two control conditions consisting of noncontingent biofeedback training and headache activity monitoring. For the noncontingent biofeedback groups, there was an average group improvement of 15.3% and an average individual improvement of 18.5% with a range of improvement from -14% to 40%. For the headache activity monitoring group, there was an average group improvement of -3.9% and an average individual improvement of -1.8% with an improvement range of -28% to 12%. The measure examined was the average headache intensity per week.

It appears from the above information that behavioral treatments of tension headache have been shown to be effective. Furthermore, evidence suggests that these improvements are maintained. Approximately one half of the treatment outcome studies in the Holroyd and Penzien (1986) meta-analysis looked at maintenance of treatment gains. Good maintenance was almost always reported with average improvements at follow-up somewhat better than immediately after treatment. There was also a high correlation between post-improvement and follow-up improvement levels ($r$ =.93). So it appears that when behavioral treatments are successful initially, they tend to stay successful (Holroyd & Penzien, 1986). This appears to be due to maintenance of treatment variables. Criticisms of behavioral treatments have mostly focused on their cost, both in terms of time and money. Most behavioral treatments tend to be time intensive (at least initially) and costly (again, at least initially). However, examination of the literature also reveals that while behavioral treatments are as good or better than pharmacologic interventions, a significant number of people still do not experience relief following behavioral intervention.

Exercise as a Treatment for Tension Headache

In this section I propose that exercise might be used as an effective treatment for tension headache. However, since this hypothesis rests on the argument that exercise might affect tension headache by diminishing the negative effects of stress, physiologically and psychologically, understanding the physiology of stress will be important in asserting the hypothesis that exercise could be an effective treatment for tension headache.

Physiology of the Stress Response. In 1926, Hans Selye, an Austrian physician, identified stress as a "nonspecific response of the body to any demand" (Selye, 1974, p. 14). He later called this pattern "the rate of wear and tear in the body" (Selye, 1974, p. 14 ), or what Everly and Rosenfeld (1981) more recently referred to as stress-related disease resulting from excessive arousal. Everly (1989) proposed that something (a stressor) brings about a physiological reaction that serves as a physiological medium linking the stressor with somatic signs and symptoms in particular organs and or systems. Regardless of whether these effects are positive or negative, a certain series of physiological events takes place within the organism--the stress response. Thus, a stressor, usually an environmental event, sets the stage for the stress response. Stressor events fall into one of two categories: psychosocial stressors and biogenic stressors. Biogenic stressors are stressors that actually "cause" the stress response to occur. It is due to their biochemical properties that they elicit the stress response (e.g., amphetamines, caffeine, or nicotine).

It is the psychosocial stressors that appear particularly relevant to a discussion of stress and headache. These are real or imagined environmental events that are capable of eliciting a stress response. Everly (1989) suggested that the determining factor of whether or not the stress response occurs is the individual's evaluation of the event. If the event is appraised to be threatening, challenging, or aversive then emotional stress will likely result. In most individuals the limbic centers for emotional arousal will be activated resulting in affective changes, visceral activation, and neuromuscular activity. These changes are identical to what Selye (1974) has termed the "stress response." According to Everly and Sobelman (1987), three primary axes are involved in the stress response: neurological, neuroendocrine, and endocrine. The neurological axis is involved in the stress response in three ways: a) direct sympathetic nervous system activation; b) direct parasympathetic nervous system activation; and c) somatic neural projections to skeletal muscles.

Activation of the sympathetic nervous system produces a generalized arousal within end organs. Hess (1957) referred to this as an "ergotropic" response. The activation of this system prepares the organism for action. The major neurotransmitter involved is norepinephrine. Specific effects of this systems activation include pupil dilation, accelerated heartbeat, elevated blood pressure, inhibited stomach motility, and constriction of blood vessels to the skin, stomach, and kidneys.

The parasympathetic nervous system produces an inhibitory slowing and restorative effect. Hess (1957) referred to this as a "trophotropic" response. It functions primarily to restore the organism back to its less activated state. Its major neurotransmitter is acetylcholine. When this system is activated during the stress response its effects include constriction of pupils, profuse salivation, cardiac inhibition, stimulated stomach secretions, and increased intestinal motility. These two components of the neurological axis react quickly but are unable to maintain arousal for extended periods (Everly, 1989).

In order to maintain a chronic state of arousal the neuroendocrine axis must become involved. The anatomical basis for the neuroendocrine stress response axis are the two adrenal medullae. Activation of this system maintains sympathetic, ergotropic arousal (Everly, 1989). When the adrenal medullary cells are stimulated, two hormones are released: norepinephrine and epinephrine. Release of these hormones is associated with increased arterial blood pressure, diminished renal blood flow, increased cardiac output, increased contraction of the skeletal muscular system, increased triglyceride levels, increased cholesterol levels, and diminished blood flow to the skin and gastrointestinal system (Everly, 1989).

Finally, skeletal muscle has also been shown to be a prime target for immediate activation during stress and emotional arousal.

When excessive, skeletal muscle activation can lead to increased limbic excitation and thus heightened emotional arousal (Everly, 1989). Of particular interest in this study is the effect the stress response can have on the musculature of the body, particularly that of the head and neck. During the stress response, muscles become mobilized for action, the muscles tense, and blood flow increases. Tension headache is often assumed to be the result of prolonged contraction of the muscles of the head and neck with no associated action (therefore the stress situation remains). Prolonged muscle contraction causes decreased blood flow to the muscles and an increase in metabolites (i.e., waste products). These changes are typically associated with pain (Dorpat & Holmes, 1955; Holmes & Wolff, 1952).

Effects of Exercise on Physiological Stress Responses

It seems apparent from the description of the stress response that the body becomes physiologically prepared for physical action. Several researchers (Chavat, Dell, & Folkow, 1964; Kraus & Rabb, 1961) propose that when the stress response does not lead to a physically active expression, the risk of physical disease (mild to extreme) and dysfunction greatly increases. The authors go on to suggest that the human stress response should lead to physical exertion or exercise as that may be the most effective way of expressing and using the stress response in a positive health-promoting manner. There are several mechanisms that occur with exercise which may help to explain why exercise might be clinically effective in the treatment of excessive stress. For, if psychosocial stressors impact physiological systems, exercise may be useful in channeling the body's physiological response in less harmful, or stress relieving, ways. These mechanisms are either active during the stress of exercise, active shortly after exercise, or are long-term mechanisms involved with exercise (Everly, 1989). Thus, it is believed that physical exercise can be used as a therapeutic tool in the prevention, treatment, and rehabilitation of stress related disease and dysfunction.

Physical activity during exercise utilizes the constituents of the stress response that can be potentially harmful to the individual. For example, during the stress response, gluconeogenic hormones (primarily cortisol) start breaking down adipose tissue for energy. A form of fat called free fatty acid (FFA) is then released into the bloodstream (Mountcastle, 1980). Unless one is exercising at a level sufficient to use the FFAs for energy, the FFAs stay in the bloodstream and are converted to triglycerides and ultimately to low-density lipoproteins (LDL). LDL has been shown to be the major source of atherosclerotic plaque associated with heart disease. Conversely, during exercise-related stress FFA levels actually decline because they are used to energize active muscles (Haskell & Fox, 1974; Miller, 1980).

A second point is that a significant demand is put on the cardiovascular system during the stress response. Cardiac output (heart rate x stroke volume), blood pressure, and resistance to peripheral blood flow all increase. Although moderate physical activity does not counteract these demands, it is less harmful (and even beneficial over time) as the exercise response is to enable the body to exercise by supplying oxygen and "fuel," and removing metabolic waste. Exercise's effect on the body depends on whether activity is frequent enough and at an intensity to keep one's heart rate in a range appropriate to improve cardiovascular functioning. Studies are mixed regarding the effectiveness of physical fitness on reducing the heart rate in stressful laboratory situations. Some studies indicated decreased heart rates in such situations (Holmes & Roth, 1985; Light, Obrist, James, & Strogatz, 1987). Other studies do not indicate such results (Brooke & Long, 1987; Cox, Evans, & Jamieson, 1979; Shulhan, Scher, & Furedy, 1986; Sothmann, Horn, Hart, & Gustafson, 1986). During the stress response there is resistance of blood flow to peripheral parts of the system such as skin. During the stress of exercise, however, resistance to blood flow in the skin decreases which helps to cool the body and decreases diastolic blood pressure (Mountcastle, 1980). Findings regarding blood pressure responses to stressors with subjects of varying fitness levels are also mixed. Light et al. (1987) found that systolic decreased while diastolic activity was not influenced in subjects who were physically fit, while Hull, Young, and Zeigler (1984) found the opposite (diastolic decreased, but systolic did not).

The short-term therapeutic mechanisms following exercise include the initiation of a state of physiological relaxation. Although exercise represents an ergotropic response mediated by the sympathetic nervous system, Balog (1978) indicates that after physical activity the body may recover by initiating a trophotropic response mediated by the parasympathetic nervous system. Also, deVries (1966) indicated that during recovery from physical activity the inhibition of gamma motor neural discharge may occur. These responses lead to short-term changes in ergotropic tone in striate and autonomic muscles resulting in striate muscle relaxation.

The potential long-term effects of exercise are most likely to emerge when exercise is aerobic in nature, endurance oriented, and practiced for at least one month. It has been hypothesized that the long-term effect of exercise is one of a higher level of physiological fitness allowing for more resistance to stress. Exercise reviews (Haskell, 1984; Layman, 1974; Martin & Dubbert, 1982; Sachs & Buffone, 1984; Sime, 1984; Weller & Everly, 1985; Wilmore, 1982) suggest that the following are some of the stress-resisting aspects of long-term exercise: increased cardiovascular efficiency, improved pulmonary function, improved glucose utilization, reduced body fat, reduced resting blood pressure, diminished autonomic nervous system reactivity, and reduced muscle tension.

A more important result of physical fitness may reside in the body's ability to recover more quickly from the physiological responses to stress. A number of studies that measured heart rate recovery revealed a faster recovery for the physically fit (Cox et al., 1979; Hollander & Seraganian, 1984; Sinyur, Schwartz, Perunnet, Brisson, & Seraganian, 1983). Keller and Seraganian (1984) compared the effects of exercise, meditation, and music appreciation upon reactions to stress. Relative to the other two options, exercise speeded the rate of electrodermal recovery from the acute stressful situation presented. McGlynn, Franklin, Lauro, and McGlynn (1983) found that a 14 week aerobic training program reduced resting blood pressure and EMG activity in the biceps brachii. A meta-analysis by Crews and Landers (1987) considered 34 studies and found that relative to their sedentary peers, aerobically fit athletes had less of a physiological response to stress and a faster recovery from the effects of stress.

Effects of Exercise on Psychological Stress Responses

Studies have shown that exercise is effective in reducing certain psychological conditions that are stress related, including anxiety and depression. Numerous studies have outlined the anxiety reducing effects of exercise (Bahrke & Morgan, 1978; Boutcher & Landers, 1987; deVries, 1968; Gellhorn, 1958; Long & Haney, 1988; Petruzzello, Landers, Hatfield, Kubitz, & Salazar, 1991; Raglin & Morgan, 1985; Sime, 1984). Both physiological and psychological hypotheses have been proposed to explain the mediating effects of exercise on anxiety.

In an attempt to find the physiological basis for decreases in anxiety, researchers have looked at reductions in muscle tension associated with exercise and diminished proprioceptive bombardment of the emotional centers in the limbic system that follow exercise (Gellhorn, 1964, 1967; Jacobson, 1978). Sime (1984) found that there seems to be substantial evidence that the release of morphine-like endogenous opiates can be associated with post-exercise decreases in anxiety and an ergotropic tone in striate and autonomic muscles (deVries, 1968, 1981; Gellhorn, 1958).

Another attempt to find the physiological basis for anxiety reduction following exercise was that of Raglin and Morgan (1985). They proposed that increased core body temperature was responsible for observed anxiolytic effects in the meta-analysis conducted by Petruzzello et al. (1991). The idea being that whole body warming reduces muscle tension. This proposition was not supported by studies in the Petruzzello et al. (1991) meta-analysis examining this position (Haight & Keatinge, 1973; Hori, Mayuzumi, Tanaka, & Tsujita, 1978).

Another physiological hypothesis proposed for the anxiety reducing effects of exercise is the "opponent process model" proposed by Solomon (1980), and it utilizes a physiological mechanism to explain the change in anxiety levels. Solomon proposed that endorphins, the body's natural peptides (i.e., endogenously produced) may be important mediators of the opponent process sequence. Specifically, Solomon proposed that endorphins could be the major substrate for the opponent process, with their presence being responsible for development of affective habituation to aversive stimuli (e.g., feeling better following repeated exposure to exercise). Solomon's position basically asserts that the brain is organized to oppose pleasurable or aversive emotional processes. This is accomplished by countering an arousing stimulus with an opposite or "opponent" reaction. Stimulus onset causes an increase in sympathetic nervous system (SNS) activity, what Solomon called the "a process." The opponent, or "b process," is aroused by the "a process" and acts to return the organism to homeostasis. The process could theoretically be produced via activity of the parasympathetic nervous system (PNS). An important component of the model is that with long-term exposure to a stimulus (e.g., exercise), the "a process" and its associated affective state (e.g., the anxiety associated with exercise) remains constant, while the opponent process and its affective state (e.g., relaxation) increases. Boutcher and Landers (1987) tested this model and found that trained runners (subjects who had adapted to running 20 minutes on a treadmill three times per week) experienced a significant decline in state anxiety at both 5 and 13 minutes after exercise. The opponent process model was also supported by a meta-analysis conducted by Petruzzello et al. (1991). Using exercise as the stimulus, the opponent process theory would predict reduced anxiety postexercise. By examining state anxiety measures administered at various intervals following exercise (e.g., 0 to 5, 5, 20, and > 30 minutes), Petruzzello et al. (1991) found anxiety to be significantly reduced. However, since both Boutcher and Landers (1987) and Petruzzello et al. only examined short-term changes in anxiety, the opponent process model has not been evaluated for long-term improvements in anxiety.

This evidence notwithstanding, it remains debatable whether or not endorphins actually mediate affective change directly (Catlin, Gorelick, Gerner, Aui, & Li, 1980; Kline, Li, & Lehman, 1977), peripherally (Farrell, Gates, Maksud, & Morgan, 1982), or not at all (Goldfarb, Hatfield, Sforzo, & Flynn, 1987; Hatfield, Santa Maria, Porges, Potts, & Mahon, 1989). Recent work by Farrell (1989) has indicated that exercise does not alter the blood-brain barrier such that peripheral endorphins can directly act upon the brain. Farrell's data support the contention that endorphin action is limited to periphery (e.g., heart) and until it can be shown unequivocally that exercise alters the blood-brain barrier, central effects appear, at best, to be speculative (Petruzzello et al., 1991).

The primary role of endorphins may be to promote physiological economy during exercise (as opposed to a primary role of affective change). Harbor and Sutton (1984) and Santiago and Edelman (1985) discussed the role of circulating endorphins in promoting reduction of ventilatory activity during exercise. In addition, Morgan (1985) has postulated that the peripheral effects of endorphins, such as adipolysis (the digestion of fat) and ventilatory restraint, may promote a central psychological effect by reducing discomfort during exercise. While problems exist with the use of endorphins as an explanation for exercise-induced affective change, it appears a tenable hypothesis.

A number of psychological hypotheses have been proposed for the stress-reducing effects of exercise. Bahrke and Morgan (1978) proposed the "distraction hypothesis" as a psychological mechanism for reduction of stress as measured by anxiety (state and trait) in the meta-analysis by Petruzzello et al. (1991). This hypothesis maintains that being distracted from stressful stimuli, or taking "time-out" from the daily routine, is responsible for the anxiety reduction observed with exercise. The meta-analysis conducted by Petruzzello et al. (1991) both supported and refuted the distraction hypothesis. For state anxiety, exercise and cognitively-based distraction therapies were equally effective at reducing anxiety. For trait anxiety, however, exercise had superior anxiolytic effects compared to cognitive strategies. Morgan and O'Connor (1989) suggest that exercise may be qualitatively different from cognitively-based distraction in at least two ways: (1) anxiety reduction following exercise lasts longer (Raglin & Morgan, 1985); and (2) long term effects of exercise as an anxiolytic therapy are greater than for cognitively-based anxiety reduction strategies, based on the results of the Petruzzello et al. (1991) meta-analysis.

Bandura's (1977) concept of self-efficacy provides another psychological explanation for the reduction of anxiety following exercise. Bandura postulated self-efficacy as a common cognitive mechanism for mediating motivation and behavior. People with high self-efficacy believe that they can do something to alter environmental events; whereas those with low self-efficacy see themselves as incapable of influencing environmental situations. This concept is supported for exercise by Long and Haney (1988). These authors compared both an 8 week progressive relaxation and an aerobic exercise (jogging) treatment in chronically stressed working women. Self-efficacy scores increased for both groups, with the exercise group exhibiting higher self-efficacy. On anxiety measures, both groups showed clinically significant reductions in trait anxiety that were maintained at 14 month follow-up.

Several researchers have reported that exercise can be an effective treatment for mild to moderate depression (Doyne, Bowman, Ossip-Klein, Osborn, McDougal-Wilson, & Neimeyer, 1983;

Simons, Epstein, McGowan, Kupfer, & Robertson, 1985). A meta-analysis conducted by North, McCullagh, & Tran, (1990) also revealed that both acute and chronic exercise programs were effective antidepressants. However, the precise agent of change is not understood.

It does not appear that physiological changes can solely account for improvements in depression from exercise. Fremont and Craighead (1984) reported no correlation between changes on the Beck Depression Inventory (BDI) and percent of decrease in exercise recovery heart rate (an index of fitness improvement). Judging from the results of a study by Doyne et al. (1983), it appears that the effects of exercise on depression are not a result of aerobic conditioning. In this study, subjects in both an aerobic (running) and a nonaerobic (weight training) group showed equal rates of improvement in depression scores. These findings suggest that a purely physiological mechanism is not solely responsible for the effectiveness of exercise as a treatment for depression. Further evidence for a nonphysiological pathway comes from the timing of improvement in depression. Although eight to ten weeks of exercise are generally required to achieve fitness changes, Fremont and Craighead (1984) and Doyne et al. (1983), showed that the antidepressant effect of exercise interventions occurred in the early weeks of treatment.

Psychological explanations have been proposed for the effectiveness of exercise with depression. Numerous "self" variables have been suggested as potentially mediating the exercise-stress relationship. Self-efficacy (Bandura, 1977), self-mastery (Ismail & Trachtman, 1973), perceived self-competence (Harter, 1978), and self-esteem enhancement (Sonstroem, 1984) may all be related to the change of stress levels measured by positive affective changes associated with exercise (North et al., 1990; Petruzzello et al., 1991; Simons et al., 1985). The basic idea appears to be that completion of an effortful task (e.g., exercise), which is important for one's goals and motives, can promote a sense of self-competence, self-mastery, or a positive feeling from having achieved a goal. The perception of one's capabilities to perform in demanding situations (e.g., exercise) affects the individuals emotional reactions. Previous self-efficacy research, however, has shown that in repeated assessments of the same situation (e.g., diving, weightlifting) self-efficacy is less directly influential on performance (Petruzzello et al. 1991). Other variables, like previous performance and one's perception of that performance, may be more influential than self-efficacy (Feltz, 1982).

Exercise is effective in decreasing stress, and impacts both physiological and psychological systems. Numerous hypotheses have been proposed to explain the effects of exercise, although no single theory seems to account for the comprehensive benefits of exercise in relieving stress. Everly (1989) has provided detailed suggestions for using exercise as a stress management intervention. He suggests that exercise should be aerobic and involve a sustained increase in oxygen demand. The exercise should be rhythmic movements that are coordinated rather than random and uncoordinated, and should not put excessive strain on joints or connective tissue. Finally, Everly

(1989) suggests that the exercise should be "egoless." This means that the exercise does not promote self-judgments or self-evaluations that risk lowering one's self-esteem. Based on the guidelines of the American College of Sports Medicine (1991) the minimum guidelines for enhancing the cardiopulmonary efficiency of otherwise healthy adults requires that the frequency and duration of the exercise should be at least three times a week for a minimum of 15 minutes of continuous exercise that maintains the heart rate at 65% to 80% of maximum.

## Purpose of Present Study

The present study was designed to assess the effectiveness of aerobic exercise in reducing symptoms of tension headache. This treatment was compared to a progressive relaxation/stress management/biofeedback treatment group to assess exercise's comparative effectiveness since the progressive relaxation "combination" has been successful in reducing tension headache. It was hypothesized that because of its stress reducing effects, aerobic exercise would be an effective treatment for tension headache.

# CHAPTER II

# METHOD

## Subjects

Tension headache sufferers were recruited from the University of North Dakota population and the surrounding community through newspaper advertisements, public service radio announcements, and physician referrals. Clinical psychology graduate students interviewed each volunteer to determine if they were eligible for the study. A total of 300 individuals indicated that they were interested in the study, of these 75 were assessed to determine appropriateness for the study. Subjects were considered appropriate for the study if they expressed a willingness to participate, were not formally involved in a program which involved components of either treatment condition (e.g., aerobic exercise, progressive relaxation), and met diagnostic criteria for either episodic or chronic tension-type headache. A total of 25 subjects were considered appropriate; of these, 18 subjects completed the study. Of the 7 subjects who dropped out of the study, 4 were from the progressive relaxation, stress management, and thermal biofeedback group (3 females and 1 male) and 3 were from the aerobic exercise group (1 female and 2 males). The 18 subjects (14 females and 4 males) who completed the study were initially assigned to one of two treatment groups: aerobic exercise (EX) (7 females and 2 males, with a mean age of 34 and an age range of 19 to 50), or progressive relaxation, stress management, and thermal biofeedback (PR) (7 females and 2 males, with a mean age of 31 and an age range of 18 to 54). The subjects were matched for gender and baseline headache activity. All subjects were treated in concordance with the "Ethical Principles In the Conduct of Research with Human Participants," (American Psychological Association, 1982).

To be eligible for participation, subjects had to meet the diagnostic criteria for either episodic tension-type headache or chronic tension-type headache (International Headache Society, 1988) (IHS). The specific diagnostic criteria for episodic tension-type headache are listed in Appendix A. The specific diagnostic criteria for chronic tension-type headache are listed in Appendix B.

In addition, individuals classified as having either episodic or chronic tension headaches were excluded from the study if they met any of the following exclusion criteria: a) history of a major psychiatric disorder, b) any evidence of possible neurological impairment (e.g., recent onset of headaches, dramatic shifts in symptom pattern), c) participation in a regular (at least three times a week for 30 minutes each time) aerobic exercise program. After completing the initial interview phase, those subjects interested and eligible to participate were required to obtain a medical release stating that it was permissible for them to engage in an aerobic exercise program (defined as exercise performed at 65-80% of maximal heart rate for 20-30 minutes for 3 to 4 days per week) (Thompson & Martin, 1983).

Treatment Protocols

Aerobic Exercise Treatment (EX). The current consensus among researchers is that aerobic exercise performed at 65-80% of maximal heart rate for 20-30 minutes on three to four days per week is optimal (American College of Sports Medicine, 1991). The EX treatment protocol was designed with these guidelines in mind. Additionally, adherence measures were incorporated to maximize the subjects' adherence to the exercise program and minimize drop-outs. This was necessary due to the fact that the health-promoting effects of exercise are often not enough to keep people in exercise programs. A large percentage of people who begin exercise programs often quit within a few months (Martin et al., 1984). Although long term adherence may or may not be critical to this study, adherence even to short term programs is still a problem. Martin et al. (1984) designed an adherence package for sedentary adults in a moderate exercise program. Based on the Martin et al. (1984) package, the following adherence measures were used to maximize subject adherence to the exercise program and minimize drop-outs: a) using a group/social setting for exercise; b) flexible goal setting (e.g., distance walked should not be as critical as exercising within agreed-upon heart rate parameters, making up sessions if missed one he/she had planned to attend); and c) individualized praise and feedback given during exercise.

Subjects in the EX group attended an initial educational session in which the treatment coordinator explained principles of aerobic exercise. At this meeting subjects were taught how to find their aerobic heart rate range. This was determined by using the formula of 220 minus their age, then taking 65% and 80% of this number. This is the guideline determined by the American College of Sports Medicine (ACSM, 1991). Also during this meeting subjects practiced monitoring their heart rates by taking their pulse to determine if they were exercising in their aerobic range.

Subjects' blood pressures were measured at the beginning and end of each exercise session with a Sunbeam model 7621 Digital Blood Pressure Monitor (Sunbeam Corp., North Shubuta, MS). This measurement was taken in a sitting position immediately prior to exercising, immediately post exercise, and immediately following the cool down period. Subjects' heart rates were monitored every five minutes during the exercise session. This was done by the subjects as they were taught to monitor their own heart rate by counting their wrist or neck pulse rate for 20 seconds, and calculating their beats per minute (BPM). This was done to ensure that heart rates were maintained within the range assigned to each subject.

All formal exercise sessions were supervised by the experimenter and undergraduate and graduate psychology students who were trained and certified by the American Red Cross in Cardiopulmonary Resuscitation. Subjects attended three exercise sessions per week for 8 consecutive weeks. Subjects began their sessions with a 10 to 15 minute warm-up period consisting of stretching and flexibility exercises (Appendix C), followed by 30 minutes of walking at an intensity level sufficient to maintain their heart rate between 65% and 80% of maximal throughout the 30 minutes. During this aerobic training phase of each exercise session, subjects were instructed to monitor their pulse every 5 minutes to ensure that their pulse rates were maintained within the prescribed training range. Every session ended with a 10 to 15 minute cool-down period, consisting of slow walking and stretching and flexibility exercises. Subjects were encouraged to exercise within the same guidelines away from the formal exercise sessions.

Subjects were provided forms to record both their formal and informal aerobic exercise sessions. At the end of the 8 week treatment subjects were urged to continue to exercise at least three times a week and to continue to record exercise sessions.

Progressive Relaxation, Stress Management, Biofeedback Treatment (PR). Subjects in the PR group followed a program developed by Penzien and Holroyd (1988) and two manuals were provided to the subjects to direct them through the program. All references made regarding treatment, manuals or forms for home practice are part of the program developed by Penzien and Holroyd (1988) and Penzien (1986a, 1986b, 1986c, 1986d). Additionally, professionally made audio tapes (Penzien, 1986a, 1986b, 1986c, 1986d) and thermometers specifically designed for use with thermal handwarming biofeedback were provided to the subjects and used as described below.

Subjects received individual training sessions one time per week at the Psychological Services Center on the University of North Dakota campus. Subjects were also expected to follow the treatment manuals provided to them throughout the week. In the initial session, subjects were educated on the principles of the PR treatment and were instructed in the assignment for the first week. Progressive relaxation was demonstrated to them and they were led through their first training session which consisted of the relaxation of 16 muscle groups (Penzien, 1986a). The PR subjects were instructed to practice their relaxation exercises at least once, preferably twice, each day. Subjects were provided relaxation tapes to aid in home practice. In addition, subjects were asked to keep relaxation logs in which they recorded the number of times they practiced relaxation during each day of the week and their relaxation level (on a Likert scale with 10 being very relaxed and 0 being not at all relaxed) both prior to and after completion of the relaxation exercises. Subjects were also instructed on how to monitor stressful situations and were instructed to do so throughout the week. Forms provided in the manuals were used for recording these situations.

Week 2 condensed the relaxation of muscles into 7 muscle groups (Penzien, 1986b). Subjects also continued to monitor stressful situations throughout the week. Week 3 condensed the relaxation of muscles into 5 muscle groups (Penzien, 1986c) and subjects continued to monitor stressful situations. In week 4, subjects continued to practice the relaxation of five muscle groups. They were also instructed in how to analyze the stressful situations they had recorded. Manuals also explained this process to aid them in home practice. Situations were analyzed to begin to make subjects aware of consistencies in situations which tended to lead to stress. In week 5, subjects were taught relaxation by recall (Penzien, 1986d). This requires the subject to recall the feelings associated with the release of tension in the muscle groups. No tensing of muscles is required. Cue-controlled relaxation was also taught in this week. Cue-controlled relaxation teaches the subject to use deep breathing with the phrase, "I am relaxed" to cue the feelings of relaxation. Subjects were also instructed in a problem-solving technique which is designed to allow them to outline and gain a better understanding of problematic situations, then develop new solutions to solve the problems. Treatment manuals provided forms for subjects to record the practicing of this technique. In week 6, subjects were instructed in the technique of handwarming biofeedback. This is a technique which uses a thermometer attached to the subject's finger which allows the subject to monitor the temperature in his or her index finger. The warmer the finger the more blood flow into the hand, which is associated with a decrease in the stress response. Subjects were instructed to practice at least once per day for 20 minutes. Forms were provided in the manual to record practice times, starting and ending temperatures, and starting and ending subjective feelings of relaxation. Subjects were also taught to examine automatic negative thoughts which might interfere with their ability to solve problems. They were taught a technique to examine, challenge, and change these thoughts. The technique taught subjects to monitor and record negative thoughts. Then subjects were taught to determine whether or not the thoughts were realistic. If not, subjects were taught to challenge and replace these thoughts with more realistic thoughts which would not be as likely to interfere with problem solving. They were instructed to practice this throughout the week. Forms were provided in the manuals to allow them to practice this technique. Subjects were also instructed to continue to practice relaxation by recall and cue controlled relaxation and to record the time practiced and subjective feelings of relaxation pre and post relaxation. In week 7, subjects were instructed to continue to practice handwarming biofeedback and to continue practicing relaxation by recall and cue controlled relaxation. They were also instructed to continue to monitor their practice on the forms provided in the manuals. Subjects were instructed in a technique which allows them to anticipate and cope with situations in which they experience a headache. It was designed to teach them to gain some control even in situations in which a headache occurs. They were instructed to practice at home and record their practice on forms provided in the manuals. Week 8 was a summary of the past 7 weeks and focused on evaluating skills learned and determining which skills were most/least effective. Subjects were also instructed to continue using those techniques judged to be most effective.

Throughout the PR treatment subjects were required to bring homework assignments to each treatment session to discuss difficulties encountered and to monitor treatment compliance.

Dependent measure questionnaires (Orientation to Life Questionnaire, State-Trait Personality Inventory-Trait Scale, and the Headache Locus of Control Scale-Revised) were administered four weeks prior to the beginning of treatment and immediately after the end of the 8 week treatment. In addition, the aerobic exercise treatment group subjects were administered these questionnaires four weeks into treatment. It was thought that this additional measurement might provide information regarding the effectiveness of this treatment midway through the treatment phase. The daily headache monitoring forms were completed 4 weeks prior to treatment, 8 weeks during treatment, and four weeks following treatment. Descriptions of the dependent measures follow below.

Dependent Measures

Headache Index. The primary dependent variable of interest was headache activity. Subjects recorded their headache activity four times daily and turned in their records to the experimenter weekly. An 11-point Likert scale that has been widely used and validated in headache treatment outcome studies (Blanchard & Andrasik, 1985; Holroyd, Holm, Hursey, Penzien, Cordingley, & Theofanous, 1988) was used to assess headache activity (Appendix D). Subjects rated headache intensity four times daily, and connected these points to represent the pattern of headache activity since their last monitoring. From these ratings the following headache data were obtained for each subject: a) average weekly headache rating (calculated by dividing the sum of each week's headache ratings by 28, the number of total observations per week), b) highest headache intensity rating per week, and c) number of headache-free days per week.

Orientation to Life Questionnaire. The Orientation to Life Questionnaire (OLQ) (Antonovsky, 1987) is a 29 item scale designed to measure the degree of an individual's "sense of coherence," (SOC) (Appendix E). Antonovsky (1987) hypothesizes three components of one's SOC: comprehensibility, manageability, and meaningfulness. The comprehensibility subscale of the OLQ assesses the degree to which individuals perceive stimuli in their environment to be orderly, predictable and understandable. The manageability subscale assesses the degree to which individuals believe they, or others who exert influence on their behalf, can manage or cope with events in their world. Finally, the meaningfulness subscale refers to how emotionally invested or committed individuals are to events in his or her world. Antonovsky proposes that an individual with a strong SOC views the world as comprehensible, manageable, and meaningful, while an individual with a weak SOC views the world as uncomprehensible, unmanageable, and not meaningful. A strong SOC is preferred over a weak SOC when a person is confronted with stressful situations or challenges.

A consistently high level of internal consistency is reported by Antonovsky (1987), with Chronbach's alphas for the three subscales ranging from .84 to .93. Finally, Antonovsky reports the the OLQ has shown adequate concurrent validity, convergent validity, and discriminant validity.

State-Trait Personality Inventory-Trait Scale. The State-Trait Personality Inventory-Trait Scale (STPI-T) (Spielberger, 1979) is a 30 item scale designed as a measure of trait anxiety, anger, and curiosity (see Appendix F). The means, standard deviations, and alpha coefficients for working adults 33 years old or older are reported in Spielberger (1979).

The following are the psychometric data for the anxiety, anger and curiosity subscales of the STPI-T. On the anxiety subscale, the mean for females is 17.98 with a standard deviation of 5.45 and an alpha coefficient of .92; the mean for males is 16.27 with a standard deviation of 4.70 and an alpha coefficient of .88. The mean for females on the anger subscale is 18.13 with a standard deviation of 4.82 and an alpha coefficient of .90; the mean for males is 17.41 with a standard deviation of 5.19 and an alpha coefficient of .88. Lastly, on the curiosity subscale, the mean for females is 28.86 with a standard deviation of 5.73 and an alpha coefficient of .95; the mean for males is 30.45 with a standard deviation of 5.64 and an alpha coefficient of .93. The alpha coefficient indicates that the STPI-T possesses adequate internal consistency.

Headache Locus of Control Scale-Revised. The Headache Locus of Control Scale-Revised (HLOC-R) (Penzien, Holm, Holroyd, Tobin, Hursey, & Brown, 1988) is a 15 item scale designed to assess subjects' locus of control beliefs about their headaches (Appendix G). Three dimensions of locus of control beliefs are assessed by the HLOC-R, including a) internality, b) health care professionals externality, and c) chance externality. Preliminary psychometric analyses of the HLOC-R (Penzien et al., 1988) revealed that the internal and two external scales are not correlated, while the two external scales are significantly correlated ($r$ =. 32). The HLOC-R scales are not correlated with measures of headache activity or physical symptoms, and the HLOC-R scale scores did not differ among the different headache diagnostic groups. In addition, HLOC-R scale scores changed in the predicted direction following behavioral treatment of headache (e.g., increased internality, decreased health care professionals externality).

# CHAPTER III

## RESULTS

The primary purpose of this study was to examine aerobic exercise's efficacy as a treatment for tension headache. Therefore, in the following analyses the aerobic exercise group (EX) was compared to a well established treatment protocol group that used progressive relaxation, stress management, and handwarming biofeedback (PR). Analyses compared these two groups to each other, as well as examining treatment effects within each group. The following paragraphs describe several 2 x 2 (Group x Pre-Post) mixed ANOVAs pertaining to subjects' responses on three questionnaires: a) State Trait Personality Inventory - Trait Scale (STPI-T), b) Orientation to Life Questionnaire (OLQ), and c) the Headache Locus of Control-Revised (HLOC-R). In addition, since these questionnaires were administered to the EX group at pre, mid, and posttreatment, separate analyses were done within the EX group to examine all three data collection points. Finally, analyses examined three variables calculated from subjects' daily headache recordings: a) headache index, b) peak headache intensity, and c) number of headache-free days. Analyses examined these three headache variables in 4-week intervals: pretreatment, first month of treatment, second month of treatment, and posttreatment. In addition, percentage of improvement scores were determined for each treatment group between pretreatment and treatment month 1, pretreatment and treatment month 2, and pretreatment and posttreatment.

State Trait Personality Inventory-Trait Scale

Three 2 x 2 (Group x Pre-Post) factorial ANOVAs were conducted on the trait subscales (anger, anxiety, curiosity) of the State-Trait Personality Inventory. Analyses revealed a significant main effect of treatment group on the dimension of curiosity, with the PR group scoring significantly higher than the EX group ($F(1,32) = 4.28$, $p < .05$) (see Figure 1). No other significant effects were found for the STPI-T anger and anxiety scales, though mean changes for both groups were in the direction of improvement (Table 1).

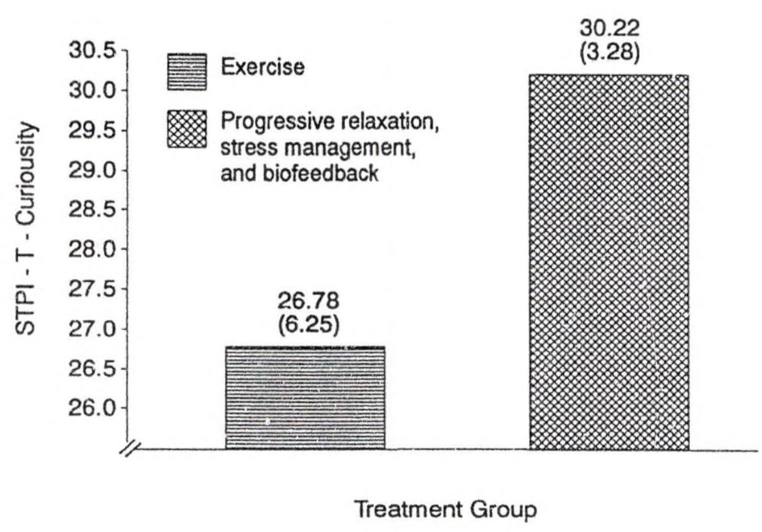



Figure 1. Main effect for treatment group means for STPI-T curiosity scores (standard deviations in parentheses).

Table 1

Means and Standard Deviations of State-Trait Personality Inventory-Trait Scales

| Group | Pre-Tx | Mid-Tx | Post-Tx |
|---|---|---|---|
| | Curiosity Scale | | |
| Ex | 27.00 (6.25) | 26.56 (5.34) | 26.56 (6.17) |
| PR | 30.00 (2.65) | N/A | 30.44 (3.97) |
| | Anger Scale | | |
| EX | 25.00(11.10) | 20.67 (5.34) | 18.56 (4.88) |
| PR | 21.56 (4.45) | N/A | 20.67 (3.94) |
| | Anxiety Scale | | |
| EX | 24.89 (6.05) | 23.33 (6.86) | 23.33 (6.42) |
| PR | 21.11 (6.23) | N/A | 21.78 (6.38) |

Note: standard deviations in parentheses, EX = exercise treatment group, PR = progressive relaxation, stress management, biofeedback treatment group, Pre-Tx = scores prior to treatment, Mid-Tx = scores midway through treatment, Post-Tx = scores post-treatment, N/A = scores not applicable to treatment group.

Orientation to Life Questionnaire

Three 2 x 2 (Group x Pre-Post) factorial ANOVAs showed no significant results within or between groups on the dimensions measured by this questionnaire. The dimensions are comprehensibility, manageability, and meaningfulness which are combined to create the dimension "Sense of Coherence" or SOC. SOC scores essentially remained unchanged from pre to posttreatment for both the EX and PR groups (means summarized in Table 2).

Table 2

Means and Standard Deviations of the Orientation to Life Questionnaire

| | Sense of Coherence Scale | | |
|---|---|---|---|
| Group | Pre-Tx | Mid-Tx | Post-Tx |
| EX | 93.56 (23.05) | 95.89 (24.62) | 93.78 (19.52) |
| PR | 102.44 (18.08) | N/A | 103.11 (25.20) |

Note: standard deviations in parentheses, EX = exercise treatment group, PR = progressive relaxation, stress management, biofeedback treatment group, Pre-Tx = scores prior to treatment, Mid-Tx = scores midway through treatment, Post-Tx = scores post-treatment, N/A = scores not applicable to treatment group.

Headache Locus of Control - Revised (HLOC-R)

The HLOC-R measures three dimensions of control beliefs: internality, health care professionals externality, and chance externality. Three 2 x 2 (Group x Pre-Post) factorial ANOVAs were conducted on the HLOC-R subscales. These analyses revealed a significant main effect of treatment group on the dimension of health professionals externality, with the PR group scoring significantly lower than the EX group ($F(1,32) = 7.73$, $p < .01$) (see Figure 2). No significant results were obtained for the internality and chance externality scales, although both scales tended to improve for both treatment groups (means summarized in Table 3).

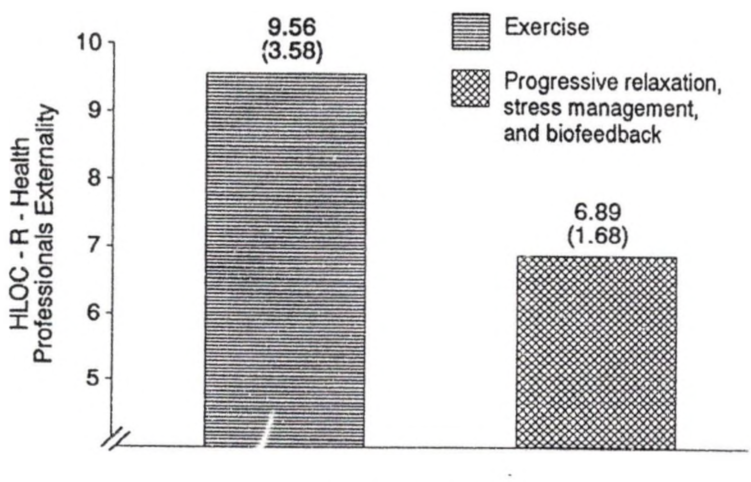



Figure 2. Main effect for treatment group means for the HLOC-R health professionals externality scores (standard deviations in parentheses).

Table 3

Means and Standard Deviations of Headache Locus of Control - Revised scales

| Group | Pre-Tx | Mid-Tx | Post-Tx |
|---|---|---|---|
| | Internality Scale | | |
| EX | 14.67 (2.92) | 16.22 (3.73) | 16.89 (4.40) |
| PR | 14.00 (4.69) | N/A | 15.44 (3.97) |
| | Chance Externality Scale | | |
| EX | 12.67 (4.61) | 11.22 (5.36) | 10.78 (6.32) |
| PR | 13.89 (4.96) | N/A | 11.11 (4.28) |
| | Health Prof. Externality Scale | | |
| EX | 9.78 (3.53) | 8.67 (3.12) | 9.33 (3.84) |
| PR | 7.00 (1.94) | N/A | 6.78 (1.48) |

Note: standard deviations in parentheses, EX = exercise treatment group, PR = progressive relaxation, stress management, biofeedback treatment group, Pre-Tx = scores prior to treatment, Mid-Tx = scores midway through treatment, Post-Tx = scores post-treatment, N/A = scores not applicable to treatment group.

Headache-Related Data

Independent two-tailed t-tests were conducted to determine the homogeneity of subjects in treatment groups prior to the beginning of the treatment phase of the experiment. These analyses revealed that the two treatment groups were homogeneous for all measures with the exception of headache peak intensity (PEK). t-tests on this dimension revealed that the mean for the EX treatment group was 7.92 (SD=1.20) and the mean for the PR treatment group was 5.97 (SD=1.28, $t\ (16)=3.33$, $p < .01$).

The primary dependent variable and the most inclusive and reliable measure of headache activity is the headache index, because it is a combination of frequency, intensity, and duration of headache activity experienced on a weekly basis. For these analyses, headache index (HINX) was averaged for each of the four months of the experiment as follows: a month of baseline recording (BASHINX), the first month of treatment (TXHINX1), the second month of treatment (TXHINX2), and a month of posttreatment recording (POSTHINX).

A 2 x 4 (Group x Month) repeated measures ANOVA failed to show a significant difference between or within the treatment groups. However, examination of each group's monthly mean does show gradual improvements (Table 4).

Table 4

Means and Standard Deviations of Headache Index (Average Headache Intensity)

| | Treatment Month | | | |
|---|---|---|---|---|
| Group | Pre-Tx | Month 1 | Month 2 | Post-Tx |
| EX | 2.62 | 2.54 | 2.00 | 1.89 |
| | (1.30) | (1.41) | (1.43) | (1.45) |
| PR | 1.98 | 1.87 | 1.61 | 1.56 |
| | (0.79) | (1.11) | (0.75) | (0.92) |

Note: standard deviations in parentheses, EX = exercise treatment group, PR = progressive relaxation, stress management, biofeedback treatment group, Pre-Tx = scores 1 month prior to treatment, Post-Tx = scores 1 month post-treatment.

The second headache-related variable was the peak intensity of headache pain experienced each week (PEK). Following the previously described system, sequential months of PEK data are indicated by BASPEK (first month of baseline recording), TXPEK1 (first month of treatment), TXPEK2 (second month of treatment), and POSTPEK (a month of post-treatment recording).

A 2 x 4 (Group x Month) repeated measures ANOVA revealed a significant main effect of treatment group on the dimension of PEK. This analysis revealed that the PEK scores were significantly lower in the PR treatment group than in the EX treatment group ($F(1,64) = 22.73$, $p < .05$) across the four months. However, the significant difference between the two treatment groups at the pre-assessment makes this difference difficult to interpret. This ANOVA also revealed a main effect of Month across the two treatment groups on the dimension of PEK ($F(3,64) =.2.85$, $p < .05$). Post hoc independent two-tailed t-tests for differences between means revealed that the significant difference occurred between BASPEK ($M = 6.94$, $SD = 1.56$) and POSTPEK ($M = 5.56$, $SD =1.62$, $t(34)= 2.62$, $p =01$). The lack of homogeneity found initially for the two treatment groups did not affect the significant effects observed between BASPEK and POSTPEK (see Figure 3).

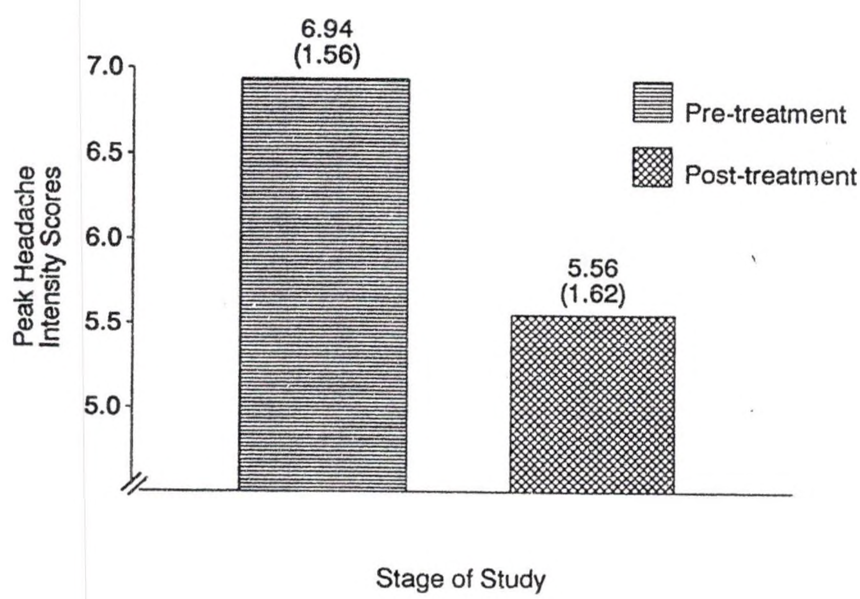



Figure 3. Mean Peak Headache Intensity scores and standard deviations (in parentheses) for treatment groups combined at pre and posttreatment.

The final headache-related variable dealt with the number of headache-free days per week (HFRE). These monthly averages are denoted by BASHFRE (baseline), TXHFRE1 (first month of treatment), TXHFRE2 (second month of treatment), and POSTHFRE (post-treatment month). A 2 x 4 (Group x Month) repeated measures ANOVA revealed no significant differences between or within treatment groups. However, examination of the monthly means does suggest some gradual improvement in both treatment groups (means summarized in Table 5).

Table 5

Means and Standard Deviations of Headache Free Days Per Month

| | Treatment Month | | | |
|---|---|---|---|---|
| Group | Pre-Tx | Month 1 | Month 2 | Post-Tx |
| EX | 1.25 | 1.56 | 2.17 | 1.69 |
| | (1.33) | (1.81) | (2.00) | (1.64) |
| PR | 1.03 | 1.47 | 1.39 | 1.64 |
| | (1.08) | (1.49) | (1.63) | (1.93) |

Note: standard deviations in parentheses, EX = exercise treatment group, PR = progressive relaxation, stress management, biofeedback treatment group, Pre-Tx = scores 1 month prior to treatment, Post-Tx = scores 1 month posttreatment.

Percentage of Improvement

Analyses were conducted to determine the percentage of improvement within each treatment group from pretreatment to posttreatment, pretreatment to treatment month 1, and pretreatment to treatment month 2. These percentages were computed for headache index (HINX) and peak headache intensity (PEK). Two 2 x 3 (Group x Phase) ANOVAs failed to show significant differences between or within groups on either headache index or peak intensity. However, examination of the mean percent improvement scores confirmed that both groups showed some improvement in both headache index (see Table 6) and peak headache intensity (see Table 7).

Table 6

Mean Percentage Improvement on the Headache Index (Average Headache Intensity)

| | Treatment Month | | |
|---|---|---|---|
| Group | Pre-tx to Month 1 | Pre-Tx to Month 2 | Pre-Tx to Post-Tx |
| EX | 8.14% | 29.43% | 35.43% |
| | (10.48) | (22.37) | (20.67) |
| PR | 12.57% | 26.29% | 27.00% |
| | (21.64) | (15.03) | (25.80) |

Note: standard deviations in parentheses, EX = exercise treatment group, PR = progressive relaxation, stress management, biofeedback treatment group, Pre-Tx to Month 1 = improvement scores from 1 month prior to treatment to one month into treatment, Pre-Tx to Month 2 = improvement scores from 1 month prior to treatment to 2 months of treatment, Pre-Tx to Post-Tx = improvement scores from 1 month prior to treatment to 1 month posttreatment.

Table 7

Mean Percentage Improvement on the Peak Headache Intensity Scale

| | Treatment Month | | |
|---|---|---|---|
| Group | Pre-Tx to Month 1 | Pre-Tx to Month 2 | Pre-Tx to Post-Tx |
| EX | 12.29% | 14.00% | 19.71% |
| | (7.67) | (11.40) | (13.48) |
| PR | 16.14% | 11.43% | 18.86% |
| | (21.89) | (12.59) | (12.91) |

Note: standard deviations in parentheses, EX = exercise treatment group, PR = progressive relaxation, stress management, biofeedback treatment group, Pre-Tx to Month 1 = improvement scores from 1 month prior to treatment to one month into treatment, Pre-Tx to Month 2 = improvement scores from 1 month prior to treatment to 2 months of treatment, Pre-Tx to Post-Tx = improvement scores from 1 month prior to treatment to 1 month posttreatment.

Treatment Compliance

Information was kept regarding the number of sessions attended by subjects in each group over the 8 weeks of treatment. Within the EX treatment group a total of 24 sessions were possible (8 weeks x 3 sessions/week). Seven subjects attended all 24 sessions and two subjects attended 22 sessions. This shows an overall weekly attendance of 98.2%. When subjects did not attend a session, an attempt was made to contact them to determine the cause of the absence. Subjects were then encouraged to continue to maintain compliance and urged to make up the session at another time during the week.

Within the PR treatment group a total of 8 sessions were possible (8 weeks x 1 session/week). Five subjects attended all eight sessions, two subjects attended seven sessions, and two subjects attended 6 sessions. This shows an overall weekly attendance of 91.7%. Weekly self-report worksheets were utilized for homework assignments during each week of the PR treatment. These worksheets were reviewed with the subjects during weekly meetings to assess progress, answer questions, and address difficulties encountered. No official record was kept of compliance based on completion of worksheets, although by monitoring weekly assignments an attempt was made to promote compliance with the program.

Power Analysis

A power analysis was conducted subsequent to the present study for each treatment group to obtain an estimate of the number of subjects necessary to decrease the variability between subjects and provide more power in determining true differences between subjects. It was determined from previous research (Holroyd & Penzien, 1986) that a 35% difference between pre and post headache index scores (average headache intensity) would be necessary for clinical significance.

If there is no set level for setting power, Sokal and Rohlf (1981) recommend setting power at .80 (conversely a beta of .20). Alpha, which is the probability of having a false positive, or rejecting the null hypothesis when it is true, is set at .05. Within the EX treatment group it was determined that in order to be 80% certain of detecting a 35% difference between pre and post headache index scores at the 5% (p = .05) level of significance, a sample size of 34 is required given the coefficient of variation of 50%.

Further, an analysis was conducted to evaluate the effect of increasing the sample size on the ability to accurately place the true population mean (of the headache index) within 95% confidence limits. The estimated population variance, provided by the present data, was used in this analysis. Within the EX treatment group, with a sample size of N = 9 (present study) the 95% confident interval around a mean of 2.62 and a standard deviation of 1.30 is ± .85 (range is 1.77 to 3.47). If the sample size was increased to N = 34, the 95% confidence interval around a mean of 2.62 and a standard deviation of 1.30 is ± .44 (range is 2.18 to 3.06). Increasing the sample size further to N= 50 shows that the 95% confidence interval around a mean of 2.62 and a standard deviation of 1.30 is ± 36 (range is 2.26 to 2.99). Therefore, it can be seen that increasing the sample size enhances the ability to detect the true mean of the headache index within the population. This decreases the variability between subjects and allows more power in detecting a true difference between headache index scores from pre to posttreatment if it exists.

The same procedure was used in conducting a power analysis on the PR treatment group. Within the PR treatment group, it was determined that in order to be 80% certain of detecting a 35% difference between pre and post headache index scores at the 5% ($p = .05$) level of significance, a sample size of 22 would be required given the coefficient of variation of 40%.

Confidence intervals were also determined for the PR treatment group using different sample sizes. Within the PR treatment group, with a sample size of $N = 9$ (present study) the 95% confidence interval around a mean of 1.98 with a standard deviation of .79 is $\pm$ .52 (range is 1.46 to 2.50). If the sample size was increased to $N = 22$, the 95% confidence interval around a mean of 1.98 and a standard deviation of .79 is $\pm$ .33 (range is 1.65 to 2.31). Increasing the sample size to $N = 50$ shows that the 95% confidence interval around a mean of 1.98 and a standard deviation of .79 is $\pm$ .22 (range is 1.76 to 2.20). Therefore it can be seen that increasing the sample size enhances the ability to detect the true headache index mean within the population. This decreases the variability between subjects and allows more power in detecting a true difference between headache index scores from pre to posttreatment if it exists.

# CHAPTER IV

## DISCUSSION

The human body's stress response includes a number of physiological systems (Everly & Sobelman, 1987; Everly, 1989), of which the most pertinent to the present study is that of the musculature of the body, especially that surrounding the head and neck. Tension headache is often assumed to be the result of prolonged contraction of the head and neck muscles without associated action (Dorpat & Holmes, 1955; Holmes & Wolff, 1952). Empirical evidence supports the clinical observation that daily stressors (e.g., traffic jams, deadlines at work) are a powerful precipitant of tension headache (Howarth, 1965; Friedman, 1979; Holm et al., 1986). Moreover, tension headache sufferers may compound this stress by a tendency to appraise and cope with events in ways likely to exacerbate or prolong the stress (e.g., avoidance, self-blame) (Holm et al., 1986).

Exercise as a treatment for tension headache is predicated on the idea that physical activity will be able to counteract or reduce the body's response to stress. The goal of the present study was to provide individuals in the exercise treatment with a means of coping with the daily stress they encounter in their lives. Given exercise's potential ability to reduce stress, it was hypothesized that aerobic exercise (EX) might serve as an effective mechanism for reducing tension headache. A structured behavioral treatment program (Penzien & Holroyd, 1988) emphasizing the use of progressive relaxation, stress management and biofeedback (PR) for treating tension headache served as a comparison treatment to the aerobic exercise treatment. Research indicates that this type of treatment has been successful in treating tension headache (Holroyd & Penzien, 1986).

Effectiveness of Exercise as a Treatment

A meta-analysis conducted by Petruzzello et al., (1991) measured stress through anxiety measures and concluded that regardless of the measures used, acute and chronic aerobic exercise was related to decreases in anxiety. The present study utilized the State Trait Personality Inventory-Trait Scale (STPI-T) to measure anxiety (as well as anger and curiosity), and found no significant changes from pretreatment to posttreatment for the EX treatment group on anxiety. The STPI-T was also administered midway through treatment to the EX group to determine if changes in anxiety had occurred. Again, no significant changes were observed. Explanations for the lack of decreases in anxiety in the present EX treatment may be found in the Petruzzello et al. (1991) meta-analysis. The meta-analysis revealed that length of training was a significant moderating variable for reductions on trait anxiety measures. Subjects training for 16 weeks or longer had larger effect sizes than subjects training for 9 weeks or less. Subjects in the present study exercised for 8 weeks, so a longer period of exercise may have been necessary to reveal significant changes in trait anxiety scores. Additionally, state anxiety measures may have been more sensitive to anxiety changes in the present study, although it could be argued that in order for exercise to effectively serve as a new coping skill, the changes that should be elicited need to be on a trait, not state, level.

As indicated earlier, research has revealed that those suffering from tension headaches are more likely to appraise and cope with potentially stressful events in ways that exacerbate and prolong the stress (Holm et al., 1986). Exercise has been postulated to be related to positive affective changes due to a number of "self" variables such as self-efficacy, self-mastery, perceived self-competence, and increased self-esteem. The other questionnaires utilized in the present study, Orientation to Life Questionnaire (OTL) and the Headache Locus of Control-Revised (HLOC-R), provide measures related to subjects' ability to cope with and believe that they have control over their environments and their headaches. Additionally, the STPI-T anger and curiosity scales may also reflect characteristic ways in which individuals approach and cope with situations in their environments. The OTL measured the subjects' "Sense of Coherence" (SOC) which is the subjects' beliefs that life is meaningful, manageable, and comprehensible. The HLOC-R questionnaire examined three dimensions of the subjects locus of control beliefs about their headaches: a) internality, b) health care professionals externality, and c) chance externality. The STPI-T anger scale assessed the subjects' perceptions of gaining control of or reducing their anger. The STPI-T curiosity scale examined how willing subjects were to exploring and entertaining new ways of coping with their environment.

In general, these measures failed to reveal significant differences pretreatment, midtreatment, or posttreatment for the EX treatment group. A significant main effect was noted in the analyses, and indicated that subjects in the exercise group had higher health care professionals externality scores on the HLOC-R questionnaire than those in the PR group. This indicates that those in the EX treatment group tended to rate themselves as relying more on health care professionals to cope with headaches than those in the the PR treatment group. On the STPI-T curiosity scale, a significant difference was found between the EX and PR treatment groups. The EX treatment group had a lower curiosity score than the PR treatment group, suggesting that those in the EX treatment group were less open to exploring and entertaining new ways of coping with their environment, than those in the PR treatment group.

These findings indicate that the EX treatment group showed no change from the beginning to the end of treatment on these measures, and on two subscales (HLOC-R health care professionals externality and STPI-T curiosity) the EX treatment group appeared even less willing to entertain new ways of coping and relied on external agents more for coping with headache than those in the PR treatment group. These findings are inconsistent with the "self" research which predicted alterations and improvements in "self variables." This discrepancy is difficult to explain, and is most likely due to small sample size rather than to components of the EX treatment. It does not appear that the lack of findings here are the result of subjects failing to comply with the exercise treatment since compliance to treatment was high.

Research suggests that exercise may be effective in increasing one's resistance to stress. This appears to occur as a result of increased physiological fitness and reduced muscle tension (Haskell, 1984; Layman, 1974; Martin & Dubbert, 1982; Sachs & Buffone, 1984; Sime, 1984; Weller & Everly, 1985; Wilmore, 1982) It is also suggested that daily stress often leads to tension headache. Therefore regular exercise should lead to a reduction in tension headache.

Results of the present study revealed that subjects in the EX treatment group showed no significant changes on the headache index measure (average headache intensity) or on the measure of headache-free days over the course of the experiment. A significant difference was found on the measure of peak headache intensity (highest reported headache per week). Those in the EX treatment group showed higher peak intensity scores compared to those in the PR treatment group. However, an independent two-tailed t-test to determine homogeneity of subjects prior to treatment revealed that those subjects in the EX treatment group began the study with significantly higher scores, and this difference was maintained throughout treatment and posttreatment. Regardless of this difference, analyses revealed a significant difference in peak headache intensity scores from pretreatment to posttreatment for both groups combined, indicating that peak headache intensity was improved over time regardless of treatment group.

The average percent improvement for the EX treatment group was calculated on the measures of headache index and peak headache intensity from pretreatment to treatment month one, pre-treatment to treatment month two, and pretreatment to post-treatment. Although there was a trend for the EX treatment group to demonstrate improvement from beginning to end of the experiment on both the headache index and the peak headache intensity measure, this was not significant.

Since it has been suggested that exercise can be effective in reducing physiological responses to stress and therefore reducing tension headache, the lack of findings on headache measures with the exercise treatment is surprising. One explanation may be that decreases in tension headache are possibly due to higher levels of physiological fitness. It is possible that the duration of the EX treatment was not long enough to achieve the level of fitness required to alter tension headache. It may also be that the physiological changes which accompany higher levels of physical fitness and reduce the body's response to stress may not really be related to the stress response which accompanies psychosocial stressors implicated in the onset of tension headache. The lack of findings may also be due to the small sample size. This explanation is supported by the finding that when both the EX and PR treatment groups were combined, a main effect was found from pretreatment to posttreatment on the measure of peak headache intensity.

Effectiveness of Progressive Relaxation, Stress Management, Biofeedback Treatment

The PR treatment was included in this study as a comparison group given PR's documented effectiveness as a treatment for tension headache (Holroyd and Penzien, 1986). In the present study, however, no significant findings were obtained for the majority of measures including the STPI-T anger and anxiety dimensions, OTL Sense of Coherence, the HLOC-R internality and chance externality dimensions, the headache index, headache-free days, and on the average percent improvements on the headache index and peak headache intensity. As discussed earlier, a significant difference was found on the STPI-T curiosity dimension indicating that those in the PR treatment group were more open to exploring new ways of coping with their environment than those in the EX treatment group. On the HLOC-R questionnaire health care professionals externality dimension, a significant difference was found between the PR and EX treatment groups, with the PR treatment group relying less on health care professionals for coping with headaches. The PR treatment group also showed significantly lower peak headache intensity scores than the EX treatment group. However, the groups were not homogeneous on this measure prior to treatment since the PR treatment group began the study with significantly lower scores.

The lack of findings on the majority of measures is likely explained by the small sample size. It is difficult to explain why the PR group did not show greater improvements on the headache index measure based on results observed in prior research (Holroyd &

Penzien, 1986). Holroyd and Penzien noted in their meta-analytic review that the average improvement rate for similar treatment programs was 43.5%. The present study's average improvement rate of 27% is substantially smaller. Based on the results of the meta-analysis conducted by Holroyd and Penzien, the present study had a number of client variables which should have predicted greater percent improvement scores, such as a greater number of female subjects, a younger subject sample, and the fact that most subjects were solicited rather than referred by physicians. Therefore, it seems that client variables in this study were perfectly suited for improvements to occur. The small sample size appears to be the most likely reason for the above results. A power analysis conducted subsequent to treatment revealed that the sample size would need to be increased to 22 subjects in order to more easily identify true differences between pre and posttreatment scores on the headache index measure. Subject compliance with weekly scheduled treatment sessions was high and therefore cannot account for poor outcome. The PR treatment, however relied heavily on home practice, and no formal measures of home practice compliance were taken. This may explain some of the discrepant findings if home practice compliance was in fact low. Previous studies, however, using home-based protocols have reported improvements at least as large as clinic-based protocols (Holroyd et al., 1988; Penzien & Holroyd, 1988).

Limitations of Present Study

Selection Bias. Subjects were volunteers therefore, the potential for selection bias exists. Initially, a seemingly large number of individuals from the community indicated an interest in participating in the study since 300 people responded to advertisements. Of those, only 75 were actually judged as appropriate and indicated a further desire to participate in additional assessment to determine possible placement in the study. Of the 75, 25 actually began treatment. Seven dropped out of the study, 4 were from the PR Group (3 females and 1 male) and 3 were from the EX group (1 female and 2 males). If the study could have been conducted in a larger populated area, a larger sample may have emerged, which would have increased statistical power. Power analyses conducted subsequent to the treatments supports this limitation. The treatment programs were also highly selective, and the requirements for participation contributed to the small sample size.

Dependent Measures. Subjects in both groups began treatment with relatively low scores on the headache index measure. The PR group headache index was (1.98) and the EX group headache index was (2.62). Therefore, it appears that a floor effect occurred and there was not much room for improvements to be measured statistically or more importantly, clinically. Obviously, larger improvements would have been more probable had headache index scores been higher. This argument does not appear to apply as strongly to the treatment group averages on the peak headache intensity dimension (EX = 7.92; PR = 5.97).

Another possible explanation for the low scores on the headache index could be that it is not sensitive to the type of discomfort or dysfunction that tension headache sufferers experience. Although this is the most widely used scale to assess headaches on a daily basis, the headache index may not be appropriate for tension headache sufferers due to their relatively low levels of activity and a resulting basement effect.

In retrospect, it may have also been useful to have gathered physiological fitness data from the subjects in the EX group throughout the treatment. In evaluating explanations of this study's results, it would have been useful to know whether subjects' fitness levels did in fact improve as a result of treatment and what effect this had on the symptoms of tension headache.

It would also have been useful to match subjects on all measures of headache activity prior to beginning treatment rather than only on the headache index, since subjects in this study were not found to be homogeneous on the measure of peak headache intensity. Within the PR treatment group formal measures of home practice compliance would have been useful to help explain discrepancies with prior research.

## Conclusion

In conclusion, this study showed few improvements in headache activity. It seems inconclusive at this time to state whether or not exercise may prove to be an effective treatment for tension headache.

APPENDICES

## APPENDIX A

## DIAGNOSTIC CRITERIA FOR EPISODIC TENSION-TYPE HEADACHE

Episodic tension-type headaches are described as recurrent episodes lasting minutes to days. The pain is typically pressing or tightening in quality, of mild or moderate intensity, bilateral in location and does not worsen with routine physical activity. Nausea is absent, but photophobia or phonophobia may be present. The specific diagnostic criteria follow:

A. At least 10 previous headache episodes fulfilling B-D listed below. Number of days with such headache <180/year (<15/month).

B. Headache lasting from 30 minutes to 7 days.

C At least 2 of the following pain characteristics:

1. Pressing/tightening (nonpulsating) quality.
2. Mild or moderate intensity (may inhibit, but does not prohibit activities).
3. Bilateral location.
4. No aggravation by walking stairs or similar routine physical activity.

D. Both of the following:

1. No nausea or vomiting (anorexia may occur).
2. Photophobia and phonophobia are absent, or one but

not the other is present.

E. At least one of the following:

1. History, physical and neurological examination do not suggest one of the following disorders: headache associated with trauma, vascular disorders, nonvascular intracranial disorder, substances or their withdrawal, noncephalic infection, metabolic disorder, disorder of cranium, neck, eyes, ears, nose, sinuses, teeth, mouth, or other cranial structures.

2. History and/or physical and/or neurological examinations do suggest such disorder, but it is ruled out by appropriate investigations.

3. Such disorder is present, but tension-type headache does not occur for the first time in close temporal relation to the disorder.

# APPENDIX B

# DIAGNOSTIC CRITERIA FOR CHRONIC TENSION-TYPE HEADACHE

Chronic tension-type headaches are present for at least 15 days a month during at least 6 months of the year. The headache is usually pressing or tightening in quality, mild or moderate in severity, bilateral in location, and does not worsen with routine physical activity. Nausea, photophobia, or phonophobia may occur. The specific diagnostic criteria follow:

A. Headaches fulfilling B-D listed below and occur at least 15 days/ month (180 days/year) for at least 6 months during a year.

B. At least 2 of the following pain characteristics:

1. Pressing/tightening quality.
2. Mild or moderate severity (may inhibit, but does not prohibit, activities).
3. Bilateral location.
4. No aggravation by walking stairs or similar routine physical activity.

C. Both of the following:

1. No vomiting.
2. No more than one of the following: Nausea, photophobia or phonophobia.

D. At least one of the following:

1. History, Physical and neurological examinations do not suggest one of the following disorders: headache associated with head trauma, vascular disorders, nonvascular intracranial disorder, substances or their withdrawal, noncephalic infection, metabolic disorder, disorder of cranium, neck, eyes, ears, nose, sinuses, teeth, mouth or other facial or cranial structures.
2. History and/or physical and/or neurological examinations do suggest such disorder, but it is ruled out by appropriate investigations.
3. Such disorder is present, but tension-type headache does not occur for the first time in close temporal relation to the disorder.

# APPENDIX C

# STRETCHING EXERCISES

Stretching should be done slowly without bouncing. Stretch to where you feel a slight, easy stretch. Hold this feeling for 5-30 seconds. As you hold this stretch, the feeling of tension should diminish. If it doesn't, just ease off slightly into a more comfortable stretch. The easy stretch reduces tension and readies the tissues for the developmental stretch.

After holding the easy stretch, move a fraction of an inch farther into the stretch until you feel mild tension again. This is the developmental stretch which should be held for 5-30 seconds. This feeling of stretch tension should also slightly diminish or stay the same. If the tension increases or becomes painful, you are over-stretching. Ease off a bit to a comfortable stretch. The developmental stretch reduces tension and will safely increase flexibility.

Hold only stretch tensions that feel good to you. The key to stretching is to be relaxed while you concentrate on the area being stretched. Your breathing should be slow, deep and rhythmical. Don't worry about how far you can stretch, stretch relaxed and limberness will become just one of the many by-products of regular stretching.

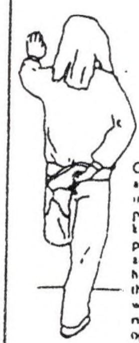
* *Note If you have had any recent surgery, muscle, or joint problem, please consult your personal health care professional before starting a stretching or exercise program*

The dotted areas are those areas of the body where you will most likely feel the stretch

3

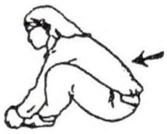
Stand a little ways from a solid support and lean on it with your forearms, head resting on hands. Bend one leg and place your foot on the ground in front of you, with the other leg straight behind. To stretch the outside of your hip, slightly turn the front of your right hip to the inside. Then project the side of your right hip to the side as you lean your shoulders very slightly in the opposite direction of your hips to create the stretch. Hold an even stretch for 30 seconds. Do both legs. Keep foot of back leg pointed straight ahead with heel flat on ground.

4



Opposite hand to opposite foot — quads and knee stretch. Hold top of left foot (from inside of foot) with right hand and gently pull heel moving toward buttocks. The knee bends at a natural angle in this position and creates a good stretch in knee and quads. Especially good to do if you have had trouble or feel pain stretching in the hurdle stretch position leaning back, or when pulling the right heel to butt with the right (same) hand. Pulling opposite hand to opposite foot does not create any adverse angles in the knee and is especially good in knee rehab and with problem knees. Hold for 30 seconds. Do both legs.

5



Put the soles of your feet together with your heels a comfortable distance from your groin. Now, put your hands around your feet and slowly pull yourself forward until you feel an easy stretch in the groin. Make your movement forward by bending from the hips and not from the shoulders. If possible, keep your elbows on the outside of your lower legs for greater stability during the stretch. Hold a comfortable stretch for 30-40 seconds.

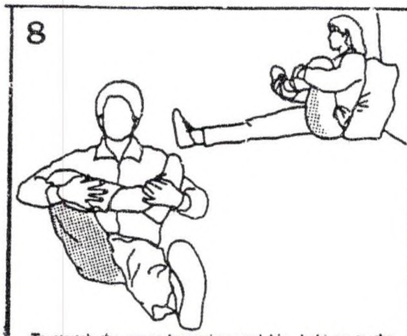
6

Repeat stretch #5

7

Sit with your right leg straight. Bend your left leg, cross your left foot over and rest it to the outside of your right knee. Then bend your right elbow and rest it on the outside of your upper left thigh, just above the knee. During the stretch use the elbow to keep this leg stationary with controlled pressure to the inside. Now, with your left hand resting behind you, slowly turn your head to look over your left shoulder, and at the same time rotate your upper body toward your left hand and arm. As you turn your upper body, think of turning your hips in the same direction (though your hips won't move because your right elbow is keeping the left leg stationary). This should give you a stretch in your lower back and side of hip. Hold for 15 seconds. Do both sides. Don't hold your breath, breathe easily.

8



To stretch the upper hamstrings and hip, hold on to the outside of your ankle with one hand, with your other hand and forearm around your bent knee. Gently pull the leg as one unit toward your chest until you feel an easy stretch in the back of the upper leg. You may want to do this stretch while you rest your back against something for support. Hold for 30 seconds. Make sure the leg is pulled as one unit so that no stress is felt in the knee.

9

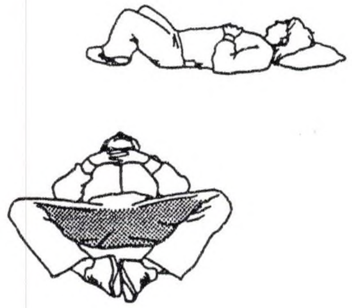
Sit with your right leg bent, with your right heel just to the outside of your right hip. The left leg is bent and the sole of your left foot is next to the inside of your upper right leg. (Try not to let your right foot flare out to the side in this position.) Now slowly lean straight back until you feel an easy stretch in your right quadriceps. Use hands for balance and support. Hold an easy stretch for 30 seconds. *Do not hold any stretches that are painful to the knee.*

10

After stretching your quads, practice tightening the buttocks on the side of the bent leg as you turn the hip over. This will help stretch the front of your hip and give a better overall stretch to upper thigh area. After contracting the butt muscles for 5-8 seconds relax, then continue to stretch quads for another 15 seconds.

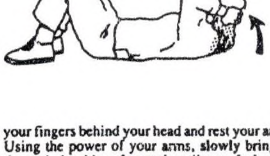
## After:

1



Relax with your knees bent and the soles of your feet together. This comfortable position will stretch your groin. Hold this for 60 seconds.

2



Interlace your fingers behind your head and rest your arms on the mat. Using the power of your arms, slowly bring your head, neck, and shoulders forward until you feel a slight stretch. Hold an easy stretch for 5 seconds. Repeat three times. Do not overstretch.

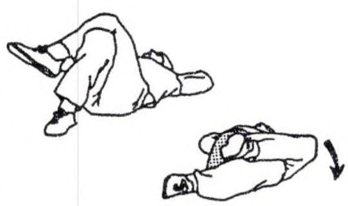
**3** Repeat stretch #2 **4**

**Shoulder Blade Pinch:** From the bent-knee position, pull your shoulder blades together to create tension in the upper back area. (As you do this your chest should move upward.) Hold this controlled tension for 4-5 seconds, then relax and gently pull your head forward as shown in stretch #2. This will help release tension and allow the neck to be stretched effectively.

**5**

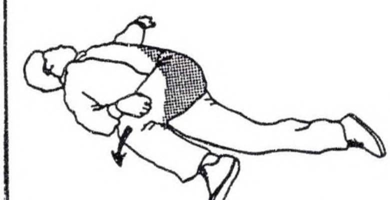
Next, straighten both legs and relax, then pull your left leg toward your chest. For this stretch keep the back of your head on the mat, if possible, but don't strain. Hold an easy stretch for 30 seconds. Repeat, pulling your right leg toward your chest.

**6**



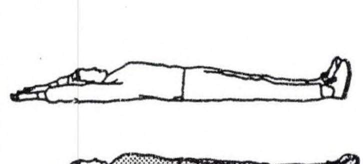
From a bent knee position, interlace your fingers behind your head and lift the left leg over the right leg. From here, use your left leg to pull your right leg toward the floor until you feel a stretch along the side of your hip and lower back. Stretch and relax. Keep the upper back, shoulders, and elbows flat on the floor. The idea is not to touch the floor with your right knee, but to stretch within your limits. Hold for 30 seconds. Repeat stretch for other side.

**7**



Bend your leg and, with your opposite hand, pull that bent leg up and over your other leg as shown above. Turn your head to look toward the hand of the arm that is straight (head should be resting on the floor). Make sure the back of your shoulders are kept flat on the floor. Now, using your hand on your thigh (resting just above the knee), pull your bent leg down toward the floor until you get the right stretch feeling in your lower back and side of hip. Keep feet and ankles relaxed. Hold a comfortable stretch for 30 seconds, each side.

**8** Repeat stretch #1 **9**



Straighten out your arms and legs. Point your fingers and toes as you stretch as far as you can. Stretch and then relax. This is a good stretch for the entire body. Hold for 5 seconds.

**10**

With your right foot resting to the outside of your left knee, pull your knee across your body toward your opposite shoulder until an easy stretch is felt on the side of the hip. Hold for 30 seconds. Do both sides.

# APPENDIX D

# HEADACHE INDEX

# WEEKLY HEADACHE RECORD

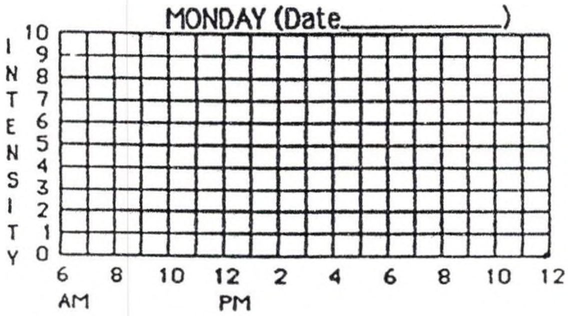
Name________________________________________ Age______ Sex: Male Female

INTENSITY – Four times each day, please update the headache graph according to the following scale.

(0) NO HEADACHE
(1)
(2) SLIGHTLY PAINFUL – I only notice my headache when I focus my attention on it.
(3)
(4) MILDLY PAINFUL – I can ignore my headache most of the time.
(5)
(6) PAINFUL – My headache is painful, but I can continue what I am doing.
(7)
(8) VERY PAINFUL – My headache makes concentration difficult, but I can perform undemanding tasks.
(9)
(10) EXTREMELY PAINFUL – I can't do anything when I have a headache.

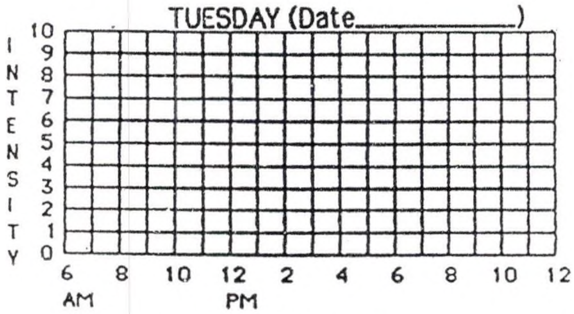
MEDICATION – Each time you take medication for headache, please indicate the type and amount of medication.

MONDAY (Date____________)



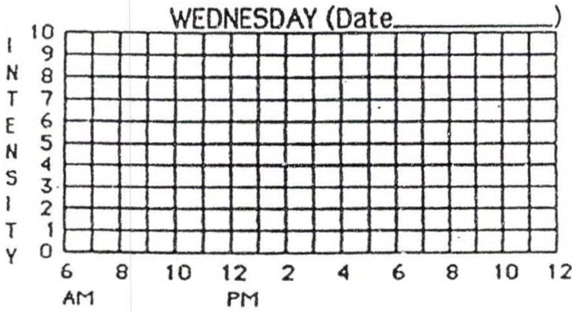

MEDICATION (type and amount)

TUESDAY (Date____________)




MEDICATION (type and amount)

WEDNESDAY (Date____________)




MEDICATION (type and amount)

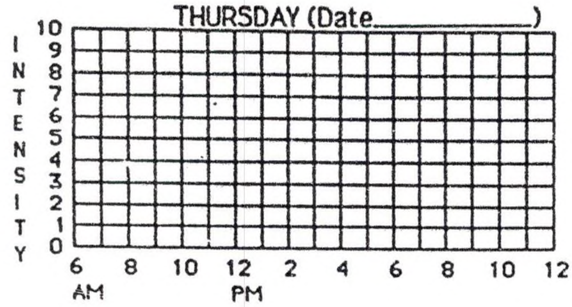
OVER

INTENSITY – Four times each day, please update the headache graph according to the following scale.

(0) NO HEADACHE
I (1)
N (2) SLIGHTLY PAINFUL – I only notice my headache when I focus my attention on it.
T (3)
E (4) MILDLY PAINFUL – I can ignore my headache most of the time.
N (5)
S (6) PAINFUL – My headache is painful, but I can continue what I am doing.
I (7)
T (8) VERY PAINFUL – My headache makes concentration difficult, but I can perform undemanding tasks.
Y (9)
(10) EXTREMELY PAINFUL – I can't do anything when I have a headache.

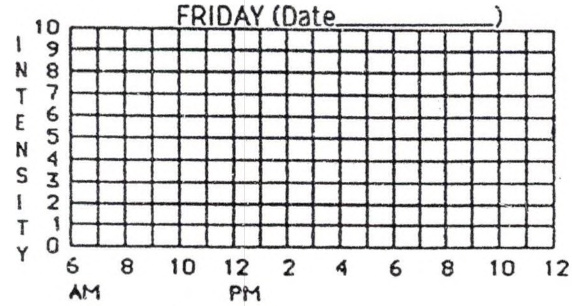
MEDICATION – Each time you take medication for headache, please indicate the type and amount of medication.

THURSDAY (Date____________)



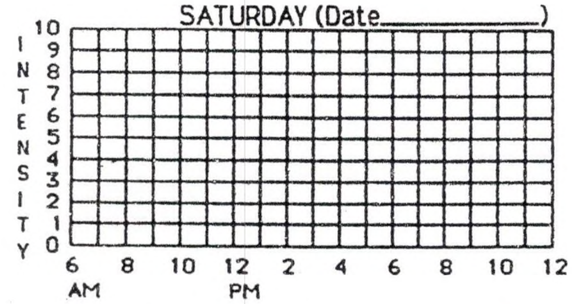

MEDICATION (type and amount)

FRIDAY (Date____________)



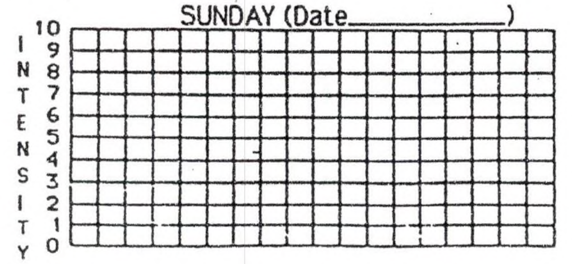

MEDICATION (type and amount)

SATURDAY (Date____________)




MEDICATION (type and amount)

SUNDAY (Date____________)




MEDICATION (type and amount)

APPENDIX E

ORIENTATION TO LIFE QUESTIONNAIRE

ORIENTATION TO LIFE QUESTIONNAIRE

Here is a series of questions relating to various aspects of our lives. Each question has seven possible answers. Please mark the number which expresses your answer, with numbers 0 and 6 being the extreme answers. If the words under 0 are right for you mark the 0 on your answer sheet; if the words under 6 are right for you, mark the 6. If you feel differently, mark the number which best expresses your feeling. Please give only one answer to each question.

1. When you talk to people, do you have the feeling that they don't understand you?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| never have this feeling | | | | | | always have this feeling |

2. In the past, when you had to do something which depended upon cooperation with others, did you have the feeling that it:

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| surely wouldn't get done | | | | | | surely would get done |

3. Think of the people with whom you come into contact daily, aside from the ones to whom you feel closest. How well do you know most of them?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| you feel that they're strangers | | | | | | you know them very well |

4. Do you have the feeling that you don't really care what goes on around you?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| very seldom or never | | | | | | very often |

5. Has it happened in the past that you were surprised by the behavior of people whom you thought you knew well?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| never happened | | | | | | always happened |

6. Has it happened that people that you counted on disappointed you?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| never happened | | | | | | always happened |

(Please Turn the Page and Continue Answering the Questions)

7. Life is:

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| full of interest | | | | | | completely routine |

8. Until now your life has had:

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| no clear goals or purpose at all | | | | | | very clear goals and purpose |

9. Do you have the feeling that you're being treated unfairly?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| very often | | | | | | very seldom or never |

10. In the past ten years your life has been:

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| full of changes without your knowing what will happen next | | | | | | completely consistent and clear |

11. Most of the things you do in the future will probably be:

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| completely fascinating | | | | | | deadly boring |

12. Do you have the feeling that you are in a unfamiliar situation and don't know what to do?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| very often | | | | | | very seldom or never |

13. What best describes how you see life:

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| one can always find a solution to painful things in life | | | | | | there is no solution to painful things in life |

14. When you think about your life, you very often:

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| feel how good it is to be alive | | | | | | ask yourself why you exist at all |

(Please Turn the Page and Continue Answering the Questions)

15. When you face a difficult problem, the choice of a solution is:

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| always confusing and hard to find | | | | | always completely clear | |

16. Doing the things you do every day is:

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| a source of deep pleasure and satisfaction | | | | | | a source of pain and boredom |

17. Your life in the future will probably be:

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| full of changes without your knowing what will happen next | | | | | | completely consistent and clear |

18. When something unpleasant happened in the past your tendency was:

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| "to eat yourself up" about it | | | | | to say "ok, that's that, I have to go on | |

19. Do you have very mixed-up feelings and ideas?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| very often | | | | | | very seldom or never |

20. When you do something that gives you a good feeling:

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| it's certain that you'll go on feeling good | | | | | it's certain that something will happen to spoil the feeling | |

21. Does it happen that you have feelings inside you would rather not feel?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| very often | | | | | | very seldom or never |

22. You anticipate that your personal life in the future will be:

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| totally without meaning or purpose | | | | | | full of meaning and purpose |

(Please Turn the Page and Continue Answering the Questions)

23. Do you think that there will <u>always</u> be people whom you'll be able to count on in the future?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| you're certain there will be | | | | | | you doubt there will be |

24. Does it happen that you have the feeling that you don't know exactly what's about to happen?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| very often | | | | | | very seldom or never |

25. Many people - even those with a strong character - sometimes feel like sad sacks (losers) in certain situations. How often have you felt this way in the past?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| never | | | | | | very often |

26. When something happened have you generally found that:

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| you overestimated or underestimated its importance | | | | | | you saw things in the right proportion |

27. When you think of difficulties you are likely to face in important aspects of your life, do you have the feeling that:

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| you will always succeed in overcoming the difficulties | | | | | | you won't succeed in overcoming the difficulties |

28. How often do you have the feeling that there's little meaning in the things you do in your daily life?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| very often | | | | | | very seldom or never |

29. How often do you have feelings that you're not sure you can keep under control?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| very often | | | | | | very seldom or never |

(THE END!)

# APPENDIX F

# STATE-TRAIT PERSONALITY INVENTORY - TRAIT SCALE

SELF-ANALYSIS QUESTIONNAIRE (X-2)

Directions: A number of statements that people have used to describe themselves are given below. Read each statement and then blacken the appropriate circle on the answer sheet to indicate how you generally feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

| | | Almost Never | Some-times | Often | Almost Always |
|---|---|---|---|---|---|
| 31. | I am a steady person. . . . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 32. | I feel like exploring my environment. . . . . . | 1 | 2 | 3 | 4 |
| 33. | I am quick tempered . . . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 34. | I feel satisfied with myself. . . . . . . . . . | 1 | 2 | 3 | 4 |
| 35. | I feel curious. . . . . . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 36. | I have a fiery temper . . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 37. | I feel nervous and restless . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 38. | I feel interested . . . . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 39. | I am a hotheaded person . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 40. | I wish I could be as happy as others seem to be | 1 | 2 | 3 | 4 |
| 41. | I feel inquisitive. . . . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 42. | I get angry when I'm slowed down by others' mistakes. . . . . . . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 43. | I feel like a failure . . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 44. | I feel eager. . . . . . . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 45. | I feel annoyed when I am not given recognition for doing good work . . . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 46. | I get in a state of tension or turmoil as I think over my recent concerns and interests . . | 1 | 2 | 3 | 4 |
| 47. | I am in a questioning mood. . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 48. | I fly off the handle. . . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 49. | I feel secure . . . . . . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 50. | I feel stimulated . . . . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 51. | When I get mad, I say nasty things. . . . . . . | 1 | 2 | 3 | 4 |
| 52. | I lack self-confidence. . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 53. | I feel disinterested. . . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 54. | It makes me furious when I am criticized in front of others . . . . . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 55. | I feel inadequate . . . . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 56. | I feel mentally active. . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 57. | When I get frustrated, I feel like hitting someone . . . . . . . . . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 58. | I worry too much over something that really does not matter . . . . . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 59. | I feel bored. . . . . . . . . . . . . . . . . . | 1 | 2 | 3 | 4 |
| 60. | I feel infuriated when I do a good job and get a poor evaluation . . . . . . . . . . . . . . . | 1 | 2 | 3 | 4 |

# APPENDIX G

# HEADACHE LOCUS OF CONTROL SCALE - REVISED

Name: ______________________________ Date:__________ Age:______ Sex: Male Female

HLOC-R

**Instructions:** Please circle the number that represents the extent to which you disagree or agree with each of the following statements. Make sure that you **answer every item** and that you **circle only one** number per item. There are no right or wrong answers, this is a measure of your personal beliefs. Read each statement carefully, but do not spend too much time on any one item.

| Strongly Disagree | Moderately Disagree | Neutral | Moderately Agree | Strongly Agree |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

| | | | | | |
|---|---|---|---|---|---|
| 1. I am in control of my headaches. | 1 | 2 | 3 | 4 | 5 |
| 2. Having regular contact with my physician is the best way for me to avoid headaches. | 1 | 2 | 3 | 4 | 5 |
| 3. Luck plays a big part in determining how soon I will recover from a headache. | 1 | 2 | 3 | 4 | 5 |
| 4. When I get headaches. I am to blame. | 1 | 2 | 3 | 4 | 5 |
| 5. My not getting headaches is largely a matter of good fortune. | 1 | 2 | 3 | 4 | 5 |
| 6. Whenever I get my headaches, I should consult a medically trained professional. | 1 | 2 | 3 | 4 | 5 |
| 7. Regarding my headaches, I can only do what my doctor tells me to do. | 1 | 2 | 3 | 4 | 5 |
| 8. If it's meant to be, I will avoid headaches. | 1 | 2 | 3 | 4 | 5 |
| 9. If I take the right actions, I can avoid headaches. | 1 | 2 | 3 | 4 | 5 |
| 10. When I don't get headaches, I'm just plain lucky. | 1 | 2 | 3 | 4 | 5 |
| 11. When I recover from a headache, it's usually because other people (for example, doctors, nurses, family, friends) have been taking good care of me. | 1 | 2 | 3 | 4 | 5 |
| 12. The main thing that affects my getting headaches is what I myself do. | 1 | 2 | 3 | 4 | 5 |
| 13. Health professionals keep me from getting headaches. | 1 | 2 | 3 | 4 | 5 |
| 14. If I take care of myself, I can avoid having headaches. | 1 | 2 | 3 | 4 | 5 |
| 15. When I get a headache, its a matter of fate. | 1 | 2 | 3 | 4 | 5 |

(Adapted from - MHLC: Wallston, Wallston, & DeVellis, 1978)

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