1-1-2002

The Effects of Regular Aerobic Exercise on Tension Headache

Brittany E. Canady

The Effects of Regular Aerobic Exercise on Tension Headache

Brittany E. Canady

Thesis submitted
To the Graduate College
Of Marshall University
In partial fulfillment of the
Requirements for the degree of
Master of Arts
In Psychology

Steven Mewaldt, Ph.D., Chair
Steven Cody, Ph.D., Chair
Helen Linkey, Ph.D.

Department of Psychology

Marshall University

Huntington, West Virginia
2002

Running head: Headache and Exercise

Abstract

The Effects of Regular Aerobic Exercise on Tension Headache

By Brittany Canady

A substantial portion of the population will suffer from headache at some point in their lives. This study examines the effect of a simple behavioral treatment for one of the two most common forms of headache, tension headache. Participants selected for the study were drawn from introductory psychology and exercise courses at Marshall University, reported having at least one tension headache per week, and exercised two or fewer times per week. Participants enrolled in an eight-week physical education aerobic exercise course through the university, and monitored their headache activity both during the class and through an eight-week baseline period. Participants experienced fewer headaches, used fewer analgesic medications, and exhibited less anxiety during the treatment period.

Table of Contents

The Effects of Regular Aerobic Exercise on Tension Headache

It can be inferred that millions of people suffer from headache each year. Studies estimate the lifetime prevalence of tension headache alone to be as high as 78% in the general population (Jensen, 1999). In a recent study over one-third of the participants reported at least one episode of some type of headache during a one year period, one-quarter suffered from non-migraine types of headache, and as much as eight percent reported having frequent headaches (Hagen, Zwart, Vatten, Stovner, & Bovim, 2000). Women tended to be more susceptible than men to both migraine and non-migraine headaches.

As such a common occurrence, non-migraine headache may be viewed as a nuisance, without any serious effects. However, a study by Holroyd, Stensland, Lipchik, Hill, O'Donnell, and Cordingley (2000) indicates that chronic tension-type headache can have a negative effect on many aspects of life. Three-quarters of participants reported using headache related disability days, with work or social functioning impairments indicated by two-thirds of subjects. Headache sufferers also reported not only more stressful events daily, but also perceived these events as more stressful than did the controls. They were also more likely to have some type of mood or anxiety disorder, with many having elevated scores on the Beck Depression Inventory.

Many people choose to simply treat their headaches with over-the-counter medications such as aspirin or ibuprofen. Many others consult their physician regarding treatment, which can result in the patient being given any one of a variety of prescription medications. Due, however, to the indication that some types of headaches correlate with

disturbed psychological functioning (e.g., Andrasik, Blanchard, Arena, Teders, Teevan, & Rodichok, 1982), research to find behavioral remedies has increased.

There is some reason to expect that behavioral therapies can be efficacious in treating chronic tension headache. Holroyd, O'Donnell, Stensland, Lipchik, Cordingley, and Carlson (2001) found that subjects receiving stress management therapy showed similar reductions six months after beginning treatment in headache activity as subjects receiving a tricyclic antidepressant (amitriptyline HCL), though the participants receiving the medication improved more quickly. Another study found that cognitive-behavioral therapy was actually more effective in reducing headaches than amitriptyline HCL, the leading prescription treatment (Holroyd, Nash, Pingel, Cordingley, & Jerome, 1991).

Another potential therapy for headache involves exercise. A review by Byrne and Byrne (1993) indicates that studies investigating the effects of exercise on depression and anxiety have fairly consistently found that increased exercise results in improved psychological functioning. Given a high rate of comorbidity of mood and anxiety disorders with chronic tension headache (Holroyd et al, 2000), and the ability of exercise to decrease levels of depression and anxiety, it might reasonably be expected that exercise would prove beneficial to tension headache sufferers.

Some popular resources already list exercise as an effective treatment for headache, due to its expected stress-relieving functions (Chillot, 1998). In fact, stress relief may be an important factor in headache treatment. According to Speilberger (1987), stress and anxiety are generally recognized as contributing to headache. Holm, Holroyd, Hursey, and Penzien (1986) found that headache sufferers reported about seven more daily hassles than non-headache controls, and rated these events as more stressful

than did the control subjects, as well. Also, as mentioned previously, stress management therapy was found to be equally as effective in treating tension headache over time as the leading prescription medication (Holroyd et al, 2001).

McGlynn, Franklin, Lauro, and McGlynn (1983) investigated the effects of aerobic conditioning on both physiological and psychological function under stress. The subjects who participated in a 14-week exercise program showed a significantly lower level of state anxiety, and, when under stress, lower state anxiety and lower blood pressure and muscle tension than the control group. Long and Haney (1988) found that decreases in anxiety among stressed working women who participated in regular exercise were similar to those of others who practiced traditional relaxation and were maintained after treatment. Keller and Seraganian (1984) found that autonomic activity of subjects who had participated in an aerobic exercise program returned to normal levels more quickly after being stressed than did that of participants in meditation or music appreciation treatments.

These results indicate that exercise may affect stress. This stress may in turn affect tension headache levels. Knowing also that other behavioral treatments have proven effective in treatment of chronic tension headache, one might anticipate that exercise would indeed be an effective treatment for tension headache. Research findings to this point, however, have been mixed.

Hammill, Cook, and Rosecrance (1996) investigated the relationship between physical therapy and tension type headache. After receiving six sessions of physical therapy, including instruction on posture, simple exercise, cold packs, and massage,

participants reported fewer headaches, and this was maintained over time as indicated by a 12-month follow-up.

A more widespread, though less controlled study has indicated that exercise can be beneficial for a number of health problems, including headache, back pain, and trouble sleeping (Andersson & Malmgren, 1986). This study, conducted through a newspaper, attracted over 1500 participants. Of the nearly 1000 who completed the final questionnaire and had increased their amount of exercise, one-fourth claimed to have decreased levels of their former complaint.

Fitterling, Martin, Gramling, Cole, and Milan (1988) studied five subjects with vascular headache first over a 3-6 week baseline period, then during a 12-week home exercise program. Four of the five subjects reported decreased headache activity, including more headache-free days, and some headache-free weeks. Similarly, these subjects reported decreased medication consumption as well.

Another study, however, found no significant differences in headache activity after a six-week exercise program (Peters, Turner, & Blanchard, 1996). Seven participants recorded headache activity in a daily headache diary for a baseline period of two weeks before beginning the exercise program. The authors report that although medication consumption, depression, and anxiety levels decreased when the pre- and post-treatment results were compared, there was no difference in actual headache activity.

In an unpublished dissertation by Witucki (1993), subjects were assigned to either an exercise condition or a progressive relaxation condition. On all post-treatment headache measures, there were no significant differences between the groups. Both

groups showed some decreases in headache intensity and headache index, a measure of intensity, frequency, and duration.

So, while many studies appear to support the idea that exercise may be a beneficial treatment program for tension headache, the results are somewhat ambiguous about actual effects on headache levels. Research indicates that exercise does improve levels of depression and anxiety in headache sufferers. However, the direct effects on headache need to be examined more closely. This study is intended to examine this complex relationship.

Method

Participants

Participants for this experiment were drawn from the student population of Marshall University and were recruited from introductory psychology and exercise classes. Each participant received an initial evaluation to determine if he or she fit the diagnostic category of either chronic or episodic tension headache as put forth by the Headache Classification Committee of the International Headache Society (1988) (see Appendix A). Any participants with non-tension-type headache or possible neurological impairment were excluded from this study, as well as those taking prescription medication for headache. Participants accepted for this study reported suffering from at least one tension headache per week and agreed to collect data for the entire 15-week period. In addition, any participant involved in a formal exercise program, or who engaged in aerobic activity three or more times a week prior to beginning the study was excluded (see Appendix B).

Twenty participants were screened, five of whom were eliminated because of failure to meet one or more of the above requirements, resulting in a sample size of 15 participants. Seven participants dropped out during the course of the study. One individual who dropped out of the study withdrew from the university, and the others withdrew from the exercise courses. Of the remaining eight participants, all were Caucasian, seven were female, and they ranged in age from 18 to 38.

Each student received university credit and a grade affecting their GPA for the exercise course, and extra credit points in introductory psychology courses. In addition, a random drawing was held for a $50 cash prize at the end of the experiment for those participants who completed both the course and the paperwork for the experiment.

Treatment

After completing the initial screening, participants registered for an eight week physical education class through Marshall University's physical education department. (Six to eight weeks is a standard treatment time for exercise studies, e.g., Light, Obrist, James, & Strogatz, 1987; Peters, Turner, & Blanchard, 1996). As aerobic activity is cited as providing the greatest health benefits (Haskell, 1987), eligible classes included any class involving aerobic activity sustained for at least 30 minutes three times a week. The class structure was expected to increase adherence among the student population because they received multiple reinforcers for their continued participation.

Each participant collected headache data for a total of 15 weeks. Only the data from the latter seven weeks of each period was included in the analysis, resulting in a total of 14 weeks of data. Three of the participants, all female, completed the treatment during the first eight weeks of the semester and the baseline during the second eight

weeks, while the other five, four females and one male, did the baseline during the first eight weeks and the exercise during the second eight weeks.

Dependent Measures

Weekly Headache Diary: Each participant kept a daily record of headache activity, which included the number of headaches, an 11 point Likert scale rating the intensity of the headaches as reported in Witucki (1993), any actions taken to relieve the headache, and the kind, dosage, and number taken of all analgesics used (both prescription and over-the-counter) (see Appendix C).

Beck Depression Inventory and Beck Anxiety Inventory: The BDI-2 (Beck, Steer, & Brown, 1996) and BAI (Beck & Steer, 1990) were used to assess levels of depression and anxiety both pre- and post-treatment, and were administered during weeks 1, 8, and 15 of the study. As indicated earlier, many studies have found links between headache and depression or anxiety, as well as an effect of exercise on these symptoms. According to Holroyd, Malinoski, Davis, and Lipchik (1999), the Beck Depression Inventory is commonly used for headache research.

Results

Headache Measures

For each of the headache measures (frequency, intensity, and analgesic use), the data within each of the 7-week treatment and baseline periods was summed for each subject, then compared using a paired samples t-test. The results are displayed in Table 1. No significant differences in total number of headaches were found between the treatment period and the baseline period ($t(7)=-1.09$, $p>.3$), nor were there differences in

the cumulative headache intensity ratings ($t(7)=1.16$, $p>.2$) when considering both those participants who had the treatment first and those who had the baseline period first.

An analysis of variance performed to address order effects, however, indicated that participants who had the treatment first had significantly fewer headaches throughout the semester (M=9.67, sd=6.35) than did those who had the baseline period first (M =22.20, sd=8.35, $F(1,6)=9.13$, $p<.025$). This may indicate that effects from the treatment phase remained in place throughout the study. Also, when considering only the second group to get treatment (n=5), there were statistically more headaches during the baseline (M=15.00, sd=4.53) than during the treatment (M =7.20, sd=3.63, $t(4)=-2.79$, $p<.05$).

Insert Table 1 about here

These results are supported by examining individual cases in the data. One participant (from the baseline first group), for example, had only 3 headaches and took no medication during the treatment, versus 16 headaches that required 9 doses of analgesics during the baseline. Another participant, who also had the baseline period first, had 22 headaches during baseline and took 7 doses of medication, while having only 6 headaches during the treatment period, with no medication used. Only two participants, both from the treatment first group, reported experiencing more headaches during treatment than during the baseline period, one of whom had 14 headaches during the treatment period, and only three during the baseline, while the other had only four during treatment, which dropped to two during the baseline.

In addition, all participants, regardless of order of treatment, used significantly fewer analgesics during the treatment period than during the baseline ($t(7)=2.44$, $p<.05$). Similarly, the dosages consumed during the baseline period also significantly differed from the treatment period ($t(7)=-2.84$. $p<.025$). As these results are not independent, only dosage is reported in Table 1.

Depression

The Beck Depression Inventory, second edition, (Beck, Steer, & Brown, 1996) was used to measure participants' levels of depression, which can be related to headache. It was administered three times during the course of the study; the scores for each administration are reported in Table 2. No participants exceeded a mild level of depression at any point during the study, and most remained within normal levels. The difference between the baseline and post-treatment scores was not significant.

Insert Table 2 about here

Anxiety

The Beck Anxiety Inventory (Beck & Steer, 1990) was used to measure anxiety levels among participants, and was administered at the same times as the Beck Depression Inventory. While no participant exceeded a mild level of anxiety on any of these measures, an analysis of variance found that there was a significant difference between scores on the two baseline measures and scores on the post-treatment measure ($F(2,14)=4.27$, $p<.05$), supporting the hypothesis that regular exercise can reduce anxiety levels (see Table 2). Further analysis showed that there were significant differences

between the post-treatment measure and both the first ($t(7)=-2.69$, $p<.05$) and second ($t(7)=-3.87$, $p<.01$) baseline measures, indicating that the difference in scores detected by the F-test were due to a difference between treatment and baseline and that baseline anxiety scores did not change significantly with order of treatment.

Discussion

It was hypothesized that increased exercise levels among the participants would lead to fewer headaches, lower headache intensity, and less use of analgesic medications for headache relief. As demonstrated above, exercise clearly decreased number of headaches at least for those participants who had the baseline period first. Exercise also decreased medication consumption for all participants. When considering that the only participants to have more headaches during treatment had the treatment period first, it appears that these individuals may have actually continued to improve throughout the course of the study, even after treatment was ended.

Even assuming that these individuals' headaches actually became more frequent due to the exercise, a case-by-case approach suggests that some subjects responded to the treatment much better than did others. As previously noted, two participants showed a great deal of improvement during the exercise period, four showed little to no improvement, and only two of the eight reported more headaches during the treatment phase than during baseline, both of whom had the treatment first.

Based on these observations and similar results obtained by previous researchers (e.g., Peters, Turner, & Blanchard, 1996), it appears that increasing exercise levels may help some headache sufferers, even if significant differences in the headache frequency and headache intensity for all subjects were not found. Future studies could examine

differences in subjects who improve with treatment versus those who do not to determine if an exercise program may be more helpful in reducing headache activity for some groups of people than others. By considering factors such as ethnicity, gender, physical fitness, intensity of exercise, and anxiety levels, a better understanding of how exercise impacts headaches may be obtained.

The main limitation of this study was the small sample size. Only eight participants completed the study, all of whom were Caucasian, and only one of whom was male. A more obvious effect may have been dulled by lack of statistical power due to such a small sample-size. Also, the lack of diversity in the sample limits the generalizability of these findings.

While an attempt was made to limit carry over effects by not including the data from the first weeks of both the baseline and treatment periods in the analysis, the order in which participants completed the baseline and treatment appears to have influenced these results. As discussed previously, three of the eight subjects took the exercise course during the first eight weeks of the semester, and effects of the exercise, such as improved physical fitness, are expected to have carried over into the subsequent baseline period, making a comparison of the treatment and baseline periods for these individuals irrelevant.

In addition, due to the timing of this experiment, stressors may have been distributed unequally throughout the study. The study began at the beginning of the semester, a relatively low-stress period, and ended at the end of the semester, during which time students were preparing for final exams. This may have resulted in more

headaches during the treatment period for the five subjects who were completing the exercise portion of the study at this time.

While more research is needed in this area, not only to further examine the possibilities of exercise as a behavioral treatment for tension headache, but also to determine for which patients it would be most useful and to investigate the mechanisms through which exercise produces change in headache activity, it appears that exercise can be very effective in treating tension headaches.

References

Andersson, G. & Malmgren, S. (1986). Changes in self-reported experienced health and psychosomatic symptoms in voluntary participants in a 1-year extensive newspaper exercise campaign. *Scandinavian Journal of Social Medicine, 14,* 141-146.

Andrasik, F., Blanchard, E.B., Arena, J.G., Teders, S.J., Teevan, R.C., & Rodichok, L.D. (1982). Psychological functioning in headache sufferers. *Psychosomatic Medicine, 44,* 171-182.

Beck, A.T. & Steer, R.A. (1990). *Beck Anxiety Inventory Manual.* San Antonio, TX: The Psychological Corporation.

Beck, A.T., Steer, R.A., & Brown, G.K. (1996). *Beck Depression Inventory Manual, 2nd ed.* San Antonio, TX: The Psychological Corporation.

Byrne, A. & Byrne, D.G. (1993). The effect of exercise on depression, anxiety and other mood states: A review. *Journal of Psychosomatic Research, 37*(6), 565-574.

Chillot, R. (1998). Stop headaches… Like magic. *Prevention*, 50(8), 98-108.

Fitterling, J.M., Martin, J.E., Gramling, S., Cole, P., & Milan, M.A. (1988). Behavioral management of exercise training in vascular headache patients: An investigation of exercise adherence and headache activity. *Journal of Applied Behavior Analysis, 21*(1), 9-19.

Hagen, K., Zwart, J.A., Vatten, L., Stovner L.J., & Bovim, G. (2000). Prevalence of migraine and non-migrainous headache—head-HUNT, a large population-based study. *Cephalalgia, 20*(10), 900-906.

Hammill, J.M., Cook, T.M., & Rosecrance, J.C. (1996). Effectiveness of a physical therapy regimen in the treatment of tension-type headache. *Headache, 36*, 149-153.

Haskell, W.L. (1987). Developing an activity plan for improving health. In W.P. Morgan & S.E Goldston (Eds.), *Exercise and Mental Health* (p.11-16). Washington: Hemisphere Publishing Corporation.

Headache Classification Committee of the International Headache Society. (1988). Classification and diagnostic criteria for headache disorders, cranial neuralgias and facial pain. *Cephalalgia, 8*(7), 1-96.

Holm, J.E., Holroyd, K.A., Hursey, K.G., & Penzien, D.B. (1986). The role of stress in recurrent tension headache. *Headache, 26*, 160-167.

Holroyd, K.A., Nash, J.M., Pingel, J.D., Cordingley, G.E., & Jerome, A. (1991). A comparison of pharmacological (amitriptyline HCL) and nonpharmacological (cognitive-behavioral) therapies for chronic tension headaches. *Journal of Consulting and Clinical Psychology, 59*(3), 387-393.

Holroyd, K.A., Malinoski, P., Davis, M.K., & Lipchik, G.L. (1999). The three dimensions of headache impact: Pain, disability and affective distress. *Pain, 83*, 571-578.

Holroyd, K.A., Stensland, M., Lipchik, G.L., Hill, K.R., O'Donnell, F.S., & Cordingley, G. (2000). Psychosocial correlates and impact of chronic tension-type headaches. *Headache, 40*, 3-16.

Holroyd, K.A., O'Donnell, F.S., Stensland, M., Lipchik, G.L., Cordingley, G.E., & Carlson, B.W. (2001). Management of chronic tension-type headache with tricyclic antidepressant medication, stress management therapy, and their combination. *Journal of the American Medical Association, 285*(17), 2208-2215.

Jensen, R. (1999). Pathophysiological mechanisms of tension-type headache: A review of epidemiological and experimental studies. *Cephalalgia, 19,* 602-621.

Keller, S. & Seraganian, P. (1984). Physical fitness level and autonomic reactivity to psychosocial stress. *Journal of Psychosomatic Research, 28*(4), 279-287.

Light, K.C., Obrist, P.A., James, S.A., & Strogatz, D.S. (1987). Cardiovascular responses to stress: II. Relationships to aerobic exercise patterns. *Psychophysiology, 24*(1), 79-86.

Long, B.C. & Haney, C.J. (1988). Long-term follow-up of stressed working women: A comparison of aerobic exercise and progressive relaxation. *Journal of Sport and Exercise Physiology, 10,* 461-470.

McGlynn, G.H., Franklin, B., Lauro, G., & McGlynn, I.K. (1983). The effect of aerobic conditioning and induced stress on state-trait anxiety, blood pressure, and muscle tension. *Journal of Sports Medicine, 23,* 341-351.

Peters, M.L., Turner, S.M., & Blanchard, E.B. (1996). The effects of aerobic exercise on chronic tension-type headache. *Headache Quarterly: Current Treatment and Research, 7*(4), 330-334.

Spielberger, C.D. (1987). Stress, emotions and health. In W.P. Morgan, & S.E. Goldston (Eds.), *Exercise and Mental Health* (p.11-16). Washington: Hemisphere Publishing Corporation.

Witucki, M.P. (1993). *A Controlled Comparison of Aerobic Exercise and Behavioral Treatment for Recurrent Tension Headache*. Unpublished doctoral dissertation, University of North Dakota, Grand Forks.

Table 1

Mean Scores on Headache Measures

	Headache Frequency	Cumulative Intensity	Medication Dosage*
Treatment			
Mean	7.1	27.8	1160.0
Standard Deviation	4.3	14.4	1241.1
Baseline			
Mean	10.4	46.9	2722.5
Standard Deviation	7.3	46.8	1984.0

*dosage in mg.

Table 2

Mean Anxiety and Depression Scores

	Pre-Study	Post-Baseline	Post-Treatment
Depression			
Mean	8.0	6.5	5.0
SD	5.5	4.3	2.5
Anxiety			
Mean	8.6	7.5	4.3
SD	3.9	5.8	4.5

Appendix A

Diagnostic Questions

1. My headaches last between 30 minutes and 7 days.	Y	N
2. I have had at least 10 such headaches.	Y	N
3. My headache is aggravated by physical activity.	Y	N
4. The pain feels pressing or tightening, not pulsating.	Y	N
5. The pain does not prevent me from activities.	Y	N
6. I feel the pain on only one side of my head.	Y	N
7. I occasionally feel sick or vomit during a headache.	Y	N
8. Light aggravates my headache.	Y	N
9. Sound aggravates my headache	Y	N
10. I have never been diagnosed with migraines.	Y	N
11. My headaches did not begin shortly after an injury.	Y	N
12. I have had headaches fewer than 15 days a month for the last six months.	Y	N

Appendix B

Initial Screening Questionnaire for Headache and Exercise Study

1. This study will involve you recording information about your headaches for 4 months, eight weeks of which will be an exercise program. Were you aware of the timeline, and are you willing to participate in a study of this length?

2. How often would you estimate that your headaches occur?

3. Have you ever been diagnosed with migraine headaches?

4. When did your headaches begin? (r/o caused by illness or trauma)

5. Have subject fill out checklist of symptoms (r/o migraine)

6. Are you currently taking any medication (prescription or OTC) for your headaches?

   List:_____

7. Are you currently taking any medication for any other purposes?

   List:_____

8. Have you ever been diagnosed with a psychiatric disorder? If so, what and when?

9. How many times a week to you currently engage in aerobic exercise?

10. What kind of exercise do you do?

11. Have you consulted with your physician about participation in an exercise program?

12. Is there any reason you think you should not take part in an exercise plan?

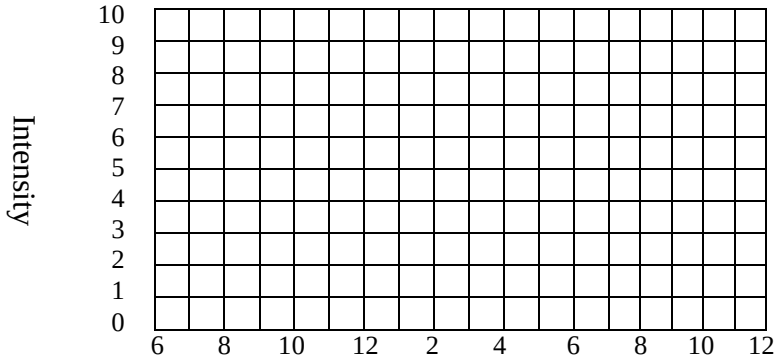
Appendix C

Weekly Headache Record

Participant number:____

Intensity: Please update the headache graph daily using 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

Monday _____ **Medication (type and amount):**



Additional tables were used for each day of the study.