2001

T‘ai Chi Chih and Its Effects on Balance and Blood Pressure

Anita Strand
University of North Dakota

Follow this and additional works at: https://commons.und.edu/pt-grad
Part of the Physical Therapy Commons

Recommended Citation
https://commons.und.edu/pt-grad/428

This Scholarly Project is brought to you for free and open access by the Department of Physical Therapy at UND Scholarly Commons. It has been accepted for inclusion in Physical Therapy Scholarly Projects by an authorized administrator of UND Scholarly Commons. For more information, please contact zeinebyousif@library.und.edu.
TAI CHI CHIH AND ITS EFFECTS ON BALANCE AND BLOOD PRESSURE

By

Anita Kay Strand
Bachelor of Science in Physical Therapy
University of North Dakota, 2000

An Independent Study
Submitted to the Graduate Faculty of the
Department of Physical Therapy
School of Medicine
University of North Dakota
In partial fulfillment of the requirements
For the degree of
Master of Physical Therapy

Grand Forks, North Dakota
May
2001
This Independent Study, submitted by Anita Kay Strand in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Faculty Preceptor, Advisor, and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

(Chairperson, Physical Therapy)

(Beverly Johnson  
(Faculty Preceptor)  
(Beverly Johnson  
Graduate School Advisor)  
(Hanna Moe  
Chairperson, Physical Therapy)
PERMISSION

Title Tai Chi Chih and Its Effects on Balance and Blood Pressure

Department Physical Therapy

Degree Master of Physical Therapy

In presenting this Independent Study Report in partial fulfillment of the requirements for a graduate degree from the University of North Dakota, I agree the Department of Physical Therapy shall make it freely available for inspection. I further agree that permission for extensive copying for scholarly purposes may be granted by the professor who supervised my work, or in her absence, by the Chairperson of the department. It is understood that any copying or publication or other use of this independent study or part thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and the University of North Dakota in any scholarly use which may be made of any material in my Independent Study Report.

Signature [Signature]

Date 13/13/00
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of Tables</td>
<td>v</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>vi</td>
</tr>
<tr>
<td>Abstract</td>
<td>vii</td>
</tr>
<tr>
<td>Chapter I. Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Chapter II. Literature Review</td>
<td>5</td>
</tr>
<tr>
<td>Chapter III. Methods</td>
<td>13</td>
</tr>
<tr>
<td>Chapter IV. Results</td>
<td>21</td>
</tr>
<tr>
<td>Chapter V. Discussion/Conclusion</td>
<td>26</td>
</tr>
<tr>
<td>Appendix A</td>
<td>31</td>
</tr>
<tr>
<td>Appendix B</td>
<td>37</td>
</tr>
<tr>
<td>Appendix C</td>
<td>40</td>
</tr>
<tr>
<td>References</td>
<td>43</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 1: Tai Chi Chih Group: Measurements and Paired Samples t-test  
Statistical Analysis ................................................................. 23

Table 2: Tai Chi Chih Group: Measurements and Wilcoxin Signed Ranks Test  
Statistical Analysis ................................................................. 24

Table 3: Walking Group: Measurements and Paired Samples t-test  
Statistical Analysis ................................................................. 25
ACKNOWLEDGEMENTS

I would like to thank Sarah Williams and Jen Baumgartner for all the hard work and long hours you spent with me working on this project, and also for all the laughs. I would also like to thank the girls from the Yoga study for your hard work you spent at the beginning of this project. Thank you also to Beverly Johnson for the time and energy you spent giving suggestions, answering questions, and reading this study. We as UND PT students are lucky to have Renee Mabey who is so knowledgeable about statistics and also willing to share that knowledge with us.

I also thank my parents for all their love, support, and confidence in me when I had doubts. You have taught me all the right things, love, hard work, morals, and made me who I am today. Thank you to my Grandma and Grandpa Flaten and to my mother and father-in-law for all your support, encouragement, and breaks from studying. Thank you to the rest of my family and friends. I will never forget all that you have done for me!

Thank you to my husband Andy for loving me unconditionally. Thank you for quizzing me, encouraging me, supporting me, and for being my patient! I couldn’t have done it without you! We are finally done!

Last, but not least, I would like to thank my Lord Jesus Christ for blessing me with awesome family and friends, for watching over me throughout my life, and for listening to my prayers. Nothing is impossible with God.
ABSTRACT

Our society is faced with more stress, injury, and disease every year. Besides the traditional medicine that we know so well in the Western cultures, people are trying more non-traditional therapies to alleviate their aches and pains. One of these non-traditional therapies that is becoming popular is Tai Chi. The purpose of this study is to determine if balance can be improved and/or blood pressure can be reduced in adults ages 20-39 by practicing Tai Chi Chih three times a week for six weeks.

Eleven subjects participated in Tai Chi Chih, and seven subjects participated in a walking program, each three times a week for six weeks. Each subject had their blood pressure checked and performed tests including Single Leg Stance, Rhythmic Weight Shift, and Functional Reach before and after the six weeks. A descriptive analysis was then performed comparing the pre- and post test scores.

From our results and current research, the researchers conclude that practicing Tai Chi Chih can reduce blood pressure. There were no significant improvements in balance, but this study is not statistically powerful enough to conclude that Tai Chi Chih does not improve balance. The researchers also conclude that Tai Chi Chih would be a useful addition to an exercise program for a patient with high blood pressure and/or balance impairments.
CHAPTER I
INTRODUCTION

Historically, the primary difference between eastern and western medical practice has been their philosophies on the relationship between the mind and body. Eastern medicine emphasizes the idea that the mind and body are interdependent, interrelated and impossible to treat as separate entities. Western medicine tends to separate mind and body and views their internal workings as distinct.

Eastern philosophies and alternative medical practices, such as Tai Chi, are gradually entering and becoming more mainstream in Western culture. The Chinese have believed in and benefited from practicing Tai Chi, with enhanced well-being and health for hundreds of years. Even so, western culture has been slow to accept this practice because of our society’s need for documentation and well-researched results before initiating the use of an unfamiliar activity such as Tai Chi. There are many different forms of Tai Chi, but this study used a regimented Tai Chi Chih program, which is a shortened and simplified form of Tai Chi. A more detailed description of Tai Chi Chih will be discussed in the Methods chapter. It is also important to note that the majority of literature sited in this study focused on Tai Chi Chuan.
Problem Statement

Recently, the National Institutes of Health identified Tai Chi on a list of alternative therapies that will be isolated for research funding as a formal area for investigation. Research has been conducted exploring the benefits of Tai Chi practice in the elderly and those with various health concerns, but is still limited. More research is needed to discover the effect a regimented Tai Chi program has on healthy young adults. If found to be beneficial to this population, Tai Chi can be hypothesized to have similar if not more profound results in all other adult populations.

Purpose

The purpose of this study is to determine if balance can be improved and/or blood pressure can be reduced in adults ages 20-39 by practicing Tai Chi Chih three times a week for six weeks.

Significance

Health care professionals in today’s diverse society need to expand their practices to include a variety of activities and treatments to help their patients reach their functional goals. In order to be successful, a broad knowledge base of both traditional western treatments and alternative therapies is needed. The more varied a therapist’s treatment options, the greater the chance for successful treatment and recovery. Some conventional treatments may work for most patients, but may have little or no effect on others. A physical therapist with a repertoire of traditional treatment options, supplemented by alternative therapies, will have more success than a physical therapist who does not
accept alternative methods of treatment when encountering patients who do not respond to traditional treatment.

This study will help determine if a regimented Tai Chi Chih program is effective in improving balance and/or decreasing blood pressure in healthy 20-39 year-old adults. Current literature supports these improvements in the older population, but there is limited research in the younger population. If Tai Chi Chih is found to be effective in this population, assumptions can be made that Tai Chi Chih is also beneficial to those with greater physical limitations and can be added to a physical therapist's options for treatment.

**Research Questions**

1. What is the effect of a regimented Tai Chi Chih program on dynamic balance in subjects ages 20-39?
2. What is the effect of a regimented Tai Chi Chih program on blood pressure in subjects ages 20-39?
3. What is the effect of a regimented Tai Chi Chih program on static balance in subjects ages 20-39?
4. What is the effect of regimented Tai Chi Chih program on limits of stability in subjects ages 20-39?
Hypotheses

Null hypothesis: A regimented Tai Chi Chih program will have no effect on dynamic balance, blood pressure, static balance, and/or limits of stability in subjects ages 20-39 after practicing three times a week for six weeks.

Alternate hypothesis: A regimented Tai Chi Chih program will improve dynamic balance, reduce blood pressure, improve static balance and/or limits of stability in subjects ages 20-39 after practicing three times a week for six weeks.
CHAPTER II

LITERATURE REVIEW

Society and the health care system are faced with more disease and injury every year. In addition, the fast paced life that people are living has increased the stresses encountered and dealt with each day. Each year, there are new drugs, herbs, therapies, exercises, and other non-traditional therapies/medicine emerging, which are complementing or even replacing the traditional medicine known so well in the Western cultures. According to a nation-wide survey, visits to nontraditional therapies/medicine exceeded visits to primary care physicians by 243 million.3

The terms used to name these non-traditional therapies/medicine are complementary or alternative. Alternative medicine is defined as “... a heterogeneous set of practices that are offered as an alternative to conventional medicine, for the preservation of health and the diagnosis and treatment of health-related problems...”4(pv) The three different groups of alternative medicine/therapies are quackery, formal, and informal. Quackery consists of harmless therapies driven by profit, and tend to prey on patients with terminal diseases. Formal therapeutic systems were developed hundreds to thousands of years ago, and require formal training by their practitioners. Acupuncture, chiropractic, herbal medicine, and osteopathy are just a few of examples of therapies that fall into the formal category. Informal therapeutic systems are developed by an individual who often creates a
school dedicated to teaching the technique or system. Examples of alternative therapies that fall into the informal category include aromatherapy, biofeedback training, sound therapy, and mind/body medicine. One form of exercise that is considered mind/body medicine is Tai Chi.

Tai Chi, meaning “supreme ultimate”, originated in China over 300 years ago, but has just emerged in the Western cultures. Initially, in the Eastern cultures, Tai Chi was known as a form of shadowboxing, but evolved as a martial art to ward off enemies which was achieved by subduing them with slow flowing movements. The emphasis of Tai Chi has changed over the years and is now more focused on body environment and mind-body interactions. The concepts of yin (negative, passive, dark) and yang (positive, active, light) are the basis for sickness and health in most traditional Chinese therapies. These forces must be balanced in order for a person to be healthy. Tai Chi is thought to have emerged from the yin and yang, with the goal to balance the Chi (vital energy). Continued practice strengthens the vital energy and can lead to a longer life, good internal and external health, and enhanced creativity.

There are many schools and forms of Tai Chi, but they all operate on the same concepts. They all consist of relaxed, smooth, and graceful movements that require the whole body-including the trunk, limbs, and breathing-to move in a coordinated fashion. The movements are carried out in pairs, left then right, to balance the yin and yang. The movements that comprise a Tai Chi form have descriptive names from nature (i.e. Bird Flaps its Wings or Daughter on the Mountain Top). Additionally, the different Tai Chi schools operate on three basic
principles. The first principle is that the body should be extended with the proper posture, but relaxed through deep breathing. This breathing should occur more from the diaphragm than from the chest. This will help the practitioners of Tai Chi in concentrating on the center of the Chi, which is located just below the navel. The second principle is that the mind must be calm and aware of the movement of the body. The last principle states that coordinated movements require sequencing of segments, starting at the waist and hips and moving to the distal limbs.

Most people today practice Tai Chi more for the health benefits than to learn a martial art. Because Tai Chi relies more on technique than on strength, people of all ages, sizes, and physical abilities can learn and enjoy the many benefits of practicing Tai Chi. In addition, when performed as a group, it also provides socialization, which is important for many individuals. The benefits of Tai Chi include improvements in pulmonary and cardiovascular capacities, improvements in balance, posture, flexibility, coordination, and overall well being.

### Pulmonary

Tai Chi, with its slow and diaphragmatic breathing pattern, has been known to be more efficient than other forms of exercise that do not concentrate on breathing. Brown et al. compared Tai Chi with bicycle ergometry. They found that the ventilatory frequency and ventilatory equivalent (VE/VO2) during Tai Chi practice was lower and the cardiovascular responses were similar. A study conducted by Schneider et al. showed Tai Chi practitioners had a lower ventilatory equivalent than wing chun practitioners.
Cardiovascular

Tai Chi is said to have the same exercise intensity as a brisk walk, which is considered to be a moderate level of exercise.\(^6\) According to Jin,\(^{15}\) mean heart rate and blood pressure responses to Tai Chi were similar to walking 6 km/hr. Jin\(^{16}\) also conducted another study in which changes in physiological functioning after Tai Chi were assessed for both beginners and practitioners. When compared to measures taken before the intervention, he found increased heart rate, increased noradrenaline excretion in urine, and decreased salivary cortisol concentration. These changes are comparable to those found with moderate exercise. The energy required to practice Tai Chi has been estimated between 4.0 and 4.6 metabolic equivalents (METS).\(^{17,18}\) Fontana,\(^{19}\) conducted a study in which 26 healthy adults participated in Tai Chi Chih, a modified form of the traditional Tai Chi. She found the energy costs to be 1.5 to 2.6 METS.

There are many studies that provide consistent data on the cardiovascular training effects of Tai Chi.\(^{14,20,21}\) In one study, the practice of Tai Chi was compared to the practice of wing chun, another Chinese martial art.\(^{14}\) During treadmill testing, there were no significant differences in maximum oxygen consumption (VO\(_2\) max) or maximum heart rate even though wing chun is more vigorous. In another study done by Lan et al,\(^{20}\) Tai Chi practitioners who practiced for 4.6 sessions a week for 11.2 months were compared to a control group. The results showed 16.1% increase in VO\(_2\) max for men and 21.3% increase VO\(_2\) max for women. When comparing elderly Tai Chi practitioners who have been performing Tai Chi for over two years to age-
matched sedentary controls, there is a significantly lower decline in VO2 max in the Tai Chi practitioners.21

Tai Chi may also be effective in reducing blood pressure. A comparable decrease in systolic and diastolic blood pressures in sedentary subjects who participated in Tai Chi and subjects who participated in a moderate intensity aerobic exercise for 12 weeks, was reported by Young.22 Channer et al23 randomly placed 126 subjects who had myocardial infarctions (three weeks prior) into Tai Chi, aerobic exercise, or control groups. Again, comparable decreases in systolic blood pressures were seen in the Tai Chi group and the aerobic exercise group.

**Balance**

In addition, there is evidence that Tai Chi has positive effects on balance and posture in elderly people. Tse and Bailey24 compared performance of five balance tests between Tai Chi practitioners and nonpractitioners. The Tai Chi practitioners did significantly better on three of the tests, including right or left leg standing, eyes open, and heel-to-toe walking. They reported the following factors as the explanation for the improvements.

1. All Tai Chi movements are slow, smooth, even and circular, with movements that flow from one to the next. This tempo facilitates a sensory awareness of all the aspects of the movement.

2. With some forms of Tai Chi, there is no exertion required because all the movements are well controlled. This results in the promotion of muscle coordination.
3. The body is constantly shifting from one foot to the other, which is likely to improve dynamic standing balance.

4. During Tai Chi, different body parts take turns playing the roles of the stabilizer and the mover. This allows smooth movements to be executed without compromising the stability of the body.

In the Atlanta Frailty and Injuries: Cooperative Study of Intervention Techniques trials, 200 subjects were randomly placed into one of three groups: Tai Chi, computerized balance training classes, or education control group. The Tai Chi group was the only group after four months of follow-up that had significantly reduced the occurrence of falls. There was also a reduction in fear of falling with both the Tai Chi group and the balance training group. Jacobson et al conducted a study on 24 men and women who participated in Tai Chi for 12 weeks. After intervention, they reported an increase in lateral stability on a tilting board. Another study, that showed improvements in balance, involved 22 people with mild balance disorders. They were tested with three objective measures and two disability questionnaires prior to and after participating in eight weeks of Tai Chi.

Despite all the focus on Tai Chi and its positive effects on balance, there is little research to determine the mechanism of these improvements. Forrest conducted a study that looked at the effects of a sixteen week training period on anticipatory postural adjustments (APA). APA is the mechanism a person uses when a postural pertubation is generated by his/her own actions. Eight healthy subjects who had no experience practicing Tai Chi were tested on a force platform before and after the sixteen week Tai Chi program. He concluded “... that one of the important
effects Tai Chi may be an improvement in the ability to utilize the elasticity of the peripheral tissues for postural stabilization.\(^{27}(pg69)\)

There are also studies showing that Tai Chi does not improve balance or postural stability. Wolf et al\(^{28}\) conducted a study involving 72 inactive elderly who participated in the Atlanta FICSIT study mentioned above. The purpose of the study was to find out whether Tai Chi and computerized balance training actually affected the subjects’ postural stability. As reflected in platform data output, only the balance training group had significant improvements in postural stability. Another study, utilizing Tai Chi training for 16 weeks, also tested subjects on a force platform and showed that subjects had no change in static sway.\(^{29}\) Wolfson et al\(^{30}\) compared balance and strength of subjects who participated in either biofeedback balance training or resistance strengthening. The biofeedback group, resistance training group, and a control group practiced Tai Chi for six months post-intervention. The biofeedback balance training group showed improved balance performance after the intervention, that also persisted after the Tai Chi training. The control group showed no changes in balance performance.

**Musculoskeletal**

There is evidence that Tai Chi has an effect on the musculoskeletal system.\(^{20,31-33}\) After living with ankylosing spondylitis for 15 years, Koh\(^{31}\), an Australian physician, practiced Tai Chi. He reported feeling stronger, feeling healthier, having better balance, and decreased blood pressure. He also stated that he was able to cut down on his medication intake. A study conducted by Lan et al\(^{20}\) showed significant improvement in thoracolumbar flexion among men and knee
range of motion among women. Also, VanDeusen and Harlowe\textsuperscript{32} conducted a study in which 46 rheumatoid arthritis subjects were placed into either a control group or a range of motion dance that included some forms of Tai Chi. The results showed the intervention group to have greater shoulder range of motion compared to the control group. Another study\textsuperscript{33} that included rheumatoid arthritis patients as subjects participating in Tai Chi showed no further break down in the rheumatic joints compared to a control group.

**Well-being**

Improved mood, improved well-being, and decreased stress are also benefits that Tai Chi provides to its practitioners. Fontana\textsuperscript{19} found some of her subjects to have decreased blood pressure when participating in Tai Chi, which supports the relaxation response of Tai Chi. Jin\textsuperscript{15} conducted a study in which subjects were exposed to mental challenges and emotional stress. The efficacy of four different stress management techniques were compared. Practicing Tai Chi was just as effective in reducing stress as was meditating Tai Chi, brisk walking, and reading neutral materials. In a study mentioned earlier, Jin\textsuperscript{16} also reported that after participating in Tai Chi, subjects reported having less tension, depression, anger, fatigue, confusion, and state-anxiety. The subjects also felt more vigorous and had less total mood disturbance.
CHAPTER III

METHODS

The final approval for this study was obtained from the University of North Dakota Institutional Review Board for the use of human subjects. A copy of the human subjects review form is located in Appendix A. During recruitment, the components of the study were explained to those interested in participating. The copy of the written informed consent form is located in Appendix B.

Subjects

To test the hypothesis for this study, human subjects were needed. Volunteers were recruited from the University of North Dakota through e-mail and the word of mouth, and consisted of students and teachers. Inclusion criteria consisted of the following:

1) between ages of 20-39

2) participate in cardiovascular exercise no more than three days a week for 40 minutes a time

3) no history of cardiac problems

4) blood pressure within normal limits

5) able to attend a majority of training sessions and both assessment sessions
Eighteen subjects participated in the study. One female in the Tai Chi Chih group was released due to scheduling conflicts. Also, two subjects who were part of the walking group dropped out because of unknown causes.

**Instrumentation**

Data collection consisted of testing performance for the single leg stance, functional reach, and rhythmic weight shift utilizing the Neurocom Balance Master® (NBM®). Blood pressure was also assessed for each subject. During the second assessment, the subjects were measured with their shoes off for their approximate height. Each specific test was conducted by the same researcher for each subject during both pre and post test days to eliminate the potential of inter-rater reliability.

**Blood Pressure**

Blood pressure was assessed before and after the intervention using a standardized blood pressure machine. Prior to the pre-test day and post-test day, the machine was calibrated by Altru Biomedical Resources. Each subject consistently had their blood pressure tested prior to the other tests to ensure a normal resting blood pressure.

The following procedure was used to assess each subject's blood pressure:

1. The subject was seated in a chair with his/her right arm resting on a table at the level of their heart.
2. The blood pressure cuff was placed on the right arm with the arrow on the cuff pointing to the brachial artery.
3. The researcher pushed the start button and waited to read the blood pressure as tested by the blood pressure machine.
4. Subjects were also questioned about caffeine intake and stress levels to assure consistent blood pressure reading.

**Single Leg Stance**

The single leg stance test was selected to measure balance with eyes open and eyes closed. It is a test widely used both in the clinic and in studies of balance and exercise. Reliability is reported to be good with internal consistency reliability coefficients of .85 to .95.34

The single leg stance was performed with eyes open two times each leg and eyes closed three times each leg. If the subject was able to balance on one leg for two minutes, that trial was complete. The tests were stopped by the researcher if the subjects lost their balance, touched the wall, touched their other leg to the floor, touched their legs together or opened their eyes during the eyes closed tests. The times kept by the researcher with a stopwatch were averaged for both eyes open and eyes closed and reported for the statistical tests.

The following directions were given to each subject prior to the test:

1. Cross your arms across your chest.
2. When the test begins, you will stand on one leg and bend the other knee to 90 degrees.
3. Do not let your legs touch.
4. When you are ready, lift your leg and I will start the stopwatch.

**Functional Reach Test**

The Functional Reach Test (FRT) was developed to measure the margin of stability during maximal forward reaching.35 It was selected by the researchers to
measure and detect a possible change in balance before and after the intervention. As tested by Duncan et al\textsuperscript{35,36} the FRT was shown to be highly reproducible with the intraclass correlation coefficient of .92.

Equipment for the Functional Reach Test consisted of a yard stick (3 inch x 48 inch) taped on the wall parallel to the floor. The subject stood on a large piece of paper that was taped to the floor next to the wall. The subject’s feet were traced to guarantee the same base of support for the second test time. The subject performed the test barefoot and with his/her dominant arm, which was placed nearest to the wall.

The following instructions were given to each subject:

1. Stand with your feet apart in a comfortable stance.
2. Make a fist with your dominant hand and bring your shoulder 90 degrees.
3. Reach forward as far as you can, keeping your heels on the floor and your knees straight. Do not twist at the waist.

One researcher would measure the starting distance by using a ruler as a straight edge to align the third metacarpalphalangeal (MCP) joint with the point on the yardstick. The subject was then told to reach forward as far as possible. The subjects were not allowed to touch the wall and there were no attempts to control the subject’s method of reach. The placement of the third MCP was again measured. A second researcher recorded the measurements to the nearest 1/8 inch. Each subject was given two practice trials and three recorded trials. The difference between the two points was calculated and the three trials were averaged for the statistical tests.
Rhythmic Weight Shift

The NBM® was used to assess rhythmic weight shift. A detailed description of the rhythmic weight shift test is found in Appendix C. This machine is widely used in the physical therapy profession for both assessment and training of balance. The subject stands on two nine inch by 60 inch force platforms on top of four load cells that measure the force under each foot.\(^{37}\) This platform communicates with a computerized system that interprets multiple data obtained during assessment and training. The computer provides visual feedback to the patient and therapist through the computer monitor, which is positioned at eye level to the subject. The cursor, which represents the patient's center of gravity (COG), moves with the patient’s minute COG displacement. As the cursor moves, it draws yellow lines showing the exact movement of the patient. Objective and quantitative data is available on printouts depicted as graphs, numerical charts and traced pictures that reveal the COG movement.

Liston and Brouwer\(^ {38}\) conducted a study, comparing the NBM® to the Berg Balance Scale and to gait velocity, which showed the NBM® to be valid for the dynamic measures of balance only. According to the Balance Master Manual,\(^ {37}\) the rhythmic weight shift test has moderate reliability when testing normal adults.

Rhythmic weight shift was the last test the subjects performed on both test days. Each subject performed the test with his/her shoes and socks off. Due to the high learning curve that exits when using the NBM, it was important to allow the subject time to become familiar with the force plates through a practice session.
The following instructions were given to each subject prior to the test:

1. Shift your weight side to side to make your cursor follow the blue square, keeping both of your feet in contact with the force plate at all times.
2. Try to move the exact same speed the square is moving.
3. Try to move as straight and smooth as you can.
4. Try to change directions at the line, just as the square does.
5. Try to be the square.
6. Take as much time as you need to feel comfortable, and when you say ready we will be begin testing.

**Intervention**

After recruiting 18 subjects, they were randomly placed into two different groups. Group 1 (n=11) served as the Tai Chi Chih group and participated in Tai Chi Chih classes three days a week for 45 minutes each session. Tai Chi Chih is a modified short form of Tai Chi that was developed by Stone.³⁹ He developed this form after finding that many students could not master the more complicated form of Tai Chi. Tai Chi Chih consists of 19 repetitive movements and one pose that are simple and more adaptable to those students with some degree of physical or functional limitation. For detailed pictures and descriptions of the 19 movements and one pose, see Stone's book⁴⁹, *Tai Chi Chih: Joy Thru Movement*.

The 19 movements and ending pose were progressively taught for the first three weeks. At the beginning and end of each class the instructor asked for feedback from the subjects about the pace of the learning and also if they wanted to review any movements. Two videotapes of the certified instructor were available to the subjects to check out if
they were absent from a class, or wanted to review over the weekend. The researchers encouraged the subjects to practice the movements learned in class on their own time.

One class a week was taught by a certified Tai Chi Chih instructor, which the researchers videotaped. The two remaining days of classes were led by the researchers, with the help of the video of the certified instructor. The majority of the classes were held at the International Center Meditation Room. This room was well lit and had hardwood floors. There was also soft background music playing during the classes. When the weather permitted, some of the classes were held outside. Subjects were either barefoot or wore socks during the classes.

Group 2 (n=8) served as the walking group and was instructed to walk three times a week for 45 minutes. They also were instructed to stretch their hamstrings during sitting or standing for one minute each leg before and after they walked. They met as a group for the first few times, but decided to walk on their own for the remainder of the six weeks. Depending on the weather, they either walked outside or inside on a track.

Data Analysis

The data from the post and pre test assessments for both the tai chi chih group and the walking group was entered into the Statistical Power for the Social Sciences (SPSS 8.0) software system. With this program, the mean, standard deviation, mean difference and standard deviation difference were calculated. These parameters were used to detect significant changes in blood pressure or balance between the initial and final assessments of blood pressure, functional reach, single leg stance, and rhythmic weight shift.
Reporting Results

Upon completion of this study, a summary of the results will be completed and sent to the Tai Chi Chih instructor and the subjects. A copy of this independent study will be given to the preceptor involved with this research project and to the Harley E French Library of Health Sciences to be available to interested parties. This study was completed to fulfill the requirements for the University of North Dakota School of Medicine and Health Sciences Physical Therapy Program.
CHAPTER IV

RESULTS

Statistical Analysis

SPSS 8.0™ program was used for statistical analysis. All data was analyzed using a two-tail design with a level of significance of $p<.05$.

Data determined to be normally distributed was analyzed using a paired samples t-test. The paired samples t-test compared difference between the pre-test (test one) and post-test (test two) scores for: functional reach, right single leg stance eyes closed (RSLS-EC), systolic and diastolic blood pressure, rhythmic weight shift left and right (RWS-L/R) for velocity and directional control, and rhythmic weight shift forward and backward (RWS-F/B) for directional control.

Data determined to be skewed or kurtosed was analyzed using the Wilcoxin signed ranks test. (Table 2) The Wilcoxin test compared the difference between the pre-intervention and post-intervention scores for right single leg stance eyes open, (RSLS-EO) left single leg stance eyes opened (LSLS-EO) and closed (LSLS-EC). All balance scores were converted to ordinal data prior to analysis by the Wilcoxin test. All single leg stance scores of 120 seconds or more were recorded as 120 seconds for statistical purposes.
Results

Means for test one and test two scores, and mean difference (test two score minus test one score) were computed for the Tai Chi Chih group (Table 1) and the walking group (Table 2).

A significant decrease in systolic blood pressure ($p = .000$) and diastolic blood pressure ($p = .000$) was found, in the Tai Chi Chih group, when comparing test one scores to test two scores. (Table 1) The mean difference was found to be 13.27 mm Hg for systolic blood pressure and 15.09 mm Hg for diastolic blood pressure. An increase was also found in the mean velocity of rhythmic weight shift left to right ($p = .078$), but was not large enough to satisfy the requirements for statistical significance. (Table 1)

In the walking group, a significant increase in left single-leg stance time with eyes closed was found when comparing test one scores to test two scores (Table 3). The mean difference was found to be −9.46 indicating the subjects were able to stand an average of 9.46 seconds longer after participating in the six week walking program.

As stated in the methods, participants were required to attend Tai Chi Chih classes three times a week or practice at home if absent. Attendance was taken before each class with the average number of Tai Chi Chih sessions not performed being two per participant with a range of zero to four.
Table 1. T'ai Chi Chih Group: Measurements and Paired Samples t-test Statistical Analysis

<table>
<thead>
<tr>
<th>TEST</th>
<th>Test 1 M ± SD</th>
<th>Test 2 M ± SD</th>
<th>(Test 2-Test 1) M ± SD</th>
<th>df</th>
<th>t-statistic</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Reach</td>
<td>17.00 ± 2.47</td>
<td>16.16 ± 3.00</td>
<td>.884 ± 2.46</td>
<td>10</td>
<td>1.131</td>
<td>.284</td>
</tr>
<tr>
<td>Systolic B.P.</td>
<td>127.00 ± 7.82</td>
<td>113.73 ± 9.09</td>
<td>13.27 ± 8.53</td>
<td>10</td>
<td>5.159</td>
<td>.000*</td>
</tr>
<tr>
<td>Diastolic B.P.</td>
<td>68.82 ± 6.54</td>
<td>53.73 ± 3.95</td>
<td>15.09 ± 4.95</td>
<td>10</td>
<td>10.114</td>
<td>.000*</td>
</tr>
<tr>
<td>R Single Leg Stance eyes closed</td>
<td>32.78 ±29.90</td>
<td>36.97 ± 35.59</td>
<td>-4.20 ± 14.87</td>
<td>10</td>
<td>-.936</td>
<td>.371</td>
</tr>
<tr>
<td>Rhythmic Weight Shift L/R (velocity)</td>
<td>7.13 ± 1.31</td>
<td>6.53 ± .89</td>
<td>.60 ± 1.02</td>
<td>10</td>
<td>1.964</td>
<td>.078</td>
</tr>
<tr>
<td>Rhythmic Weight Shift F/B (velocity)</td>
<td>4.15 ± .73</td>
<td>4.27 ± .77</td>
<td>-.13 ± .56</td>
<td>10</td>
<td>-.755</td>
<td>.467</td>
</tr>
<tr>
<td>Rhythmic Weight Shift L/R (directional control)</td>
<td>89.82 ± 2.48</td>
<td>90.09 ± 4.50</td>
<td>-.27 ± 5.10</td>
<td>10</td>
<td>-.177</td>
<td>.863</td>
</tr>
<tr>
<td>Rhythmic Weight Shift F/B (directional control)</td>
<td>80.82 ± 11.68</td>
<td>85.82 ± 6.19</td>
<td>-5.00 ± 13.25</td>
<td>10</td>
<td>-1.251</td>
<td>.239</td>
</tr>
</tbody>
</table>

* .000 < p = .05 indicating a significant difference
Table 2. T'ai Chi Chih Group: Measurements and Wilcoxin Signed Ranks Test Statistical Analysis

<table>
<thead>
<tr>
<th>TEST</th>
<th>Test M ± SD</th>
<th>Test 2 M ± SD</th>
<th>(Test 2-Test 1) M ± SD</th>
<th>n</th>
<th>z-score</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Single Leg Stance</td>
<td>106.61 ± 31.29</td>
<td>117.23 ± 7.43</td>
<td>-10.62 ± 25.39</td>
<td>10</td>
<td>-1.095</td>
<td>.273</td>
</tr>
<tr>
<td>eyes open</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L Single Leg Stance</td>
<td>114.23 ± 19.15</td>
<td>114.27 ± 19.00</td>
<td>-4.55 ± .15</td>
<td>10</td>
<td>-1.000</td>
<td>.317</td>
</tr>
<tr>
<td>eyes open</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L Single Leg Stance</td>
<td>31.56 ± 23.27</td>
<td>34.47 ± 33.60</td>
<td>-2.91 ± 19.25</td>
<td>10</td>
<td>-.356</td>
<td>.722</td>
</tr>
<tr>
<td>eyes closed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3. Walking Group: Measurements and Paired Samples t-test Statistical Analysis

<table>
<thead>
<tr>
<th>TEST</th>
<th>Test 1 M ± SD</th>
<th>Test 2 M ± SD</th>
<th>(Test 2-Test 1) M ± SD</th>
<th>df</th>
<th>t-statistic</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Reach</td>
<td>15.63 ± 3.29</td>
<td>16.47 ± 3.49</td>
<td>- .84 ± 1.06</td>
<td>4</td>
<td>-1.781</td>
<td>.150</td>
</tr>
<tr>
<td>Systolic B.P.</td>
<td>122.80 ± 12.56</td>
<td>122.80 ± 12.56</td>
<td>10.60 ± 13.89</td>
<td>4</td>
<td>1.707</td>
<td>.163</td>
</tr>
<tr>
<td>Diastolic B.P.</td>
<td>68.40 ± 11.26</td>
<td>60.20 ± 7.09</td>
<td>8.20 ± 10.55</td>
<td>4</td>
<td>1.734</td>
<td>.157</td>
</tr>
<tr>
<td>R Single Leg Stance eyes open</td>
<td>95.76 ± 24.76</td>
<td>107.40 ± 28.18</td>
<td>-11.64 ± 18.79</td>
<td>4</td>
<td>-1.385</td>
<td>.238</td>
</tr>
<tr>
<td>Right Single Leg Stance eyes closed</td>
<td>18.91 ± 10.95</td>
<td>27.02 ± 6.26</td>
<td>-8.11 ± 12.34</td>
<td>4</td>
<td>-1.470</td>
<td>.216</td>
</tr>
<tr>
<td>Left Single Leg Stance eyes open</td>
<td>96.93 ± 33.15</td>
<td>108.40 ± 25.94</td>
<td>-11.47 ± 34.34</td>
<td>4</td>
<td>-7.470</td>
<td>.497</td>
</tr>
<tr>
<td>Left Single Leg Stance eyes closed</td>
<td>15.91 ± 7.08</td>
<td>25.37 ± 7.52</td>
<td>-9.46 ± 3.68</td>
<td>4</td>
<td>-5.739</td>
<td>.005*</td>
</tr>
<tr>
<td>Rhythmic Weight Shift L/R (velocity)</td>
<td>6.40 ± .39</td>
<td>6.20 ± .51</td>
<td>.20 ± .30</td>
<td>4</td>
<td>1.491</td>
<td>.210</td>
</tr>
<tr>
<td>Rhythmic Weight Shift F/B (velocity)</td>
<td>4.12 ± .54</td>
<td>3.88 ± .86</td>
<td>.24 ± .38</td>
<td>4</td>
<td>1.419</td>
<td>.229</td>
</tr>
<tr>
<td>Rhythmic Weight Shift L/R (directional control)</td>
<td>89.20 ± 2.78</td>
<td>87.80 ± 3.27</td>
<td>1.40 ± 3.78</td>
<td>4</td>
<td>.828</td>
<td>.454</td>
</tr>
<tr>
<td>Rhythmic Weight Shift F/B (directional control)</td>
<td>82.60 ± 5.13</td>
<td>83.20 ± 10.59</td>
<td>- .60 ± 12.90</td>
<td>4</td>
<td>-.104</td>
<td>.922</td>
</tr>
</tbody>
</table>

* .005 < p = .05 indicating a significant difference
CHAPTER IV
DISCUSSION/CONCLUSION

The findings of this study show that the practice of Tai Chi Chih resulted in significant improvements in both systolic and diastolic blood pressure in subjects ranging from ages 20-39 years. There were no significant changes in blood pressure in the walking group. There were no significant changes in balance in neither the Tai Chi Chih group nor the walking group.

The significant blood pressure decrease in this study is interesting, considering the subjects' age range. Blood pressure is not usually a medical concern in this age group, as was the case for the subjects of this study. High blood pressure is a problem in this country, and the age of onset is becoming younger. This is true because of the increasingly poor eating habits and exercise habits that a majority of people have adopted.

Another area of interest to consider in this study is the timing of the test day post-intervention. The post-test day was conducted the weekend before finals week, which is a busy and stressful time for both students and teachers. Stress can lead to increases in blood pressure, but the results of this study showed significant decreases in blood pressure. This study agrees with the other studies documented in the literature review, that Tai Chi Chih can help with relaxation, stress reduction, and enhance overall well-being.
The timing of the post-test day could also have had an affect on the balance results of this study. The timing could be looked as in a negative way, because of possible decreased motivation of the subjects to participate in the three balance tests. Decreased motivation and concentration could have resulted in poor scores in the balance tests.

Another area of concern in this study, is the organization of the walking group. It was difficult to find a time to meet, due to schedule conflicts, at which the walking group could walk and stretch together. Thus, the walking group was held responsible to walk on their own and record the days and times they walked each week. This may have affected the compliance issue, and therefore resulted in the insignificant changes in balance and blood pressure.

The response of the subjects to Tai Chi Chih was variable. One subject felt that Tai Chi Chih was too spiritual, and he mentioned that he received spiritual fulfillment through other methods. Other subjects were either uninterested or unmotivated to participate and simply went through the motions without intensity or meditation. Three of the subjects expressed much enjoyment and fulfillment from Tai Chi Chih and felt they would continue practicing after the study was finished. Considering this variable response, it would have been interesting to analyze which patient's scores had significant changes.

**Clinical Implications**

Research in the field of physical therapy is important for many reasons including effectiveness of tests and treatments and also reimbursement issues. This study focused on the influence of Tai Chi Chih on balance and blood pressure.
Balance and blood pressure are issues physical therapists deal with extensively. The results of this study, along with the results of other studies, prove that Tai Chi Chih may be one method of intervention physical therapists can utilize in adjunct with other treatment methods for patients with high blood pressure.

The results of this study showed no significant improvements in balance in neither the Tai Chi Chih group nor the walking group. These results are not surprising considering the subjects of this study were younger, and also had no balance impairments. Therefore, this study does not provide significant evidence that Tai Chi Chih does not improve balance. But, the results of other studies mentioned in the literature review lead the researchers to conclude that Tai Chi Chih can improve balance in elderly subjects and in subjects with balance impairments. It is important for physical therapists to consider different treatment options for different patients, considering their age, abilities, needs, and their interests. Tai Chi Chih can be one of many different treatment options a physical therapist can teach a patient with balance impairments.

**Limitations of Study**

The most significant limitation to this study was the small sample size. In order for research to be significant, there should be at least ten subjects in each group. The bigger the sample size, the more accurately the data represents the population. There were initially eleven subjects in the Tai Chi Chih group, but one subject discontinued due to scheduling conflict. In the walking group, there were initially eight subjects, but three subjects discontinued to reasons unknown to the researchers. The size of the UND Meditation Center did not allow for a larger number of subjects
without impeding in the subjects’ movement space and increasing possible
distractions.

The length of time of this study is also a limitation of this study. For the Tai
Chi Chih group, the six weeks included the learning of the 19 movements and one
end pose. Some Tai Chi practitioners feel that in order to feel the benefits of Tai Chi,
one must practice for years. Also, six weeks is the minimum amount of time that
cardiovascular and strength benefits are seen after exercising three to four days a
week.

Motivation is a factor that could affect the results of this study and is a
concern of this study. A common trend in studies that involve exercise is compliance
problems. The subjects recruited for this study had an interest mainly in Tai Chi, but
knew the possibility of being placed in the walking group. Interest and understanding
play a crucial role in good compliance of an exercise program. Walking is not the
most popular choice of exercise for the subjects’ age population of this study.
Exercise, which is more active and exciting like aerobics, running, or playing sports,
would be more stimulating for the younger age population.

Future Research

While the results of this study and past studies are encouraging, more research
is needed about Tai Chi Chih and it’s benefits, especially in subjects of the younger
age group. It would be beneficial to conduct studies of differing durations to answer
the question of the best duration of Tai Chi Chih training. Another suggestion for
future research is to compare Tai Chi Chih to other conventional balance training
activities.
Conclusion

The researchers of this study feel that Tai Chi Chih would be a useful addition to an exercise program for a patient with high blood pressure and/or balance impairments. There are both advantages and disadvantages to Tai Chi Chih as compared to traditional physical therapy. The advantages will be discussed first. Because Tai Chi Chih is most often practiced in a group setting, it would be a less expensive intervention than one on one physical therapy. Also, exercise should be a lifestyle change, instead of brief periods of exercise whenever there is pain or functional difficulties. Tai Chi Chih is designed to be a lifelong practice, which is necessary to improve and maintain the many benefits experienced when practicing. Last, Tai Chi Chih can be used for all levels of patients, from an elderly patient who is having difficulty walking, to a middle-aged patient with a stressful job and home situation.

The disadvantages of Tai Chi Chih are minimal and easy to work around. First, safety is an issue when working with elderly patients and patients with balance impairments. It would be important to have multiple instructors or health care professionals in a class with numerous patients with balance problems. Second, traditional physical therapy provides a tailored rehabilitation program specific to the patient's needs. Also, the physical therapist would be able to closely monitor progress and change the rehabilitation program as necessary. These issues remind the researchers that Tai Chi Chih is one option to many treatment options, and also that it can be used in conjunction with traditional physical therapy.
APPENDIX A
1. ABSTRACT: (LIMIT TO 200 WORDS OR LESS AND INCLUDE JUSTIFICATION OR NECESSITY FOR USING HUMAN SUBJECTS.) The purpose of this study is to determine if a 5 week structured t'ai chi chih program promotes a change in balance or blood pressure in a population of 20-39 year old subjects. T'ai chi chih is a form of exercise and meditation developed in the far east that combines deep diaphragmatic breathing with good posture while performing slow, gentle movements. T'ai chi chih has been effective in decreasing chronic pain, blood pressure, and heart rate, improving balance and strength and encouraging overall relaxation. Although there are many benefits to using t'ai chi chih, most of the literature relates to the elderly population. Most of this limited literature lacks sophistication in the measurement of balance and fails to address the affects t'ai chi chih has on dynamic and functional balance. Therefore, our focus in performing this study will be to add to the body of knowledge of t'ai chi chih and to investigate the impact it has on blood pressure and balance in the population, ages 20-39. The investigators will recruit subjects by visiting classrooms throughout the UND campus. Considering previous studies, we expect that both the t'ai chi chih and walking groups will have decreased blood pressure and improved balance.
PLEASE NOTE: Only information pertinent to your request to utilize human subjects in your project or activity should be included on this form. Where appropriate attach sections from your proposal (if seeking outside funding).

2. PROTOCOL: (Describe procedures to which humans will be subjected. Use additional pages if necessary. Attach any surveys, tests, questionnaires, interview questions, examples of interview questions (if qualitative research), etc., the subjects will be asked to complete.)

Recruitment: The investigators will recruit subjects by visiting classrooms throughout the UND campus. A total of 20-30 subjects are required for this study.

Selection: Subjects will meet the requirements if they are 20-39 years of age, attend, work, or teach at UND and are currently engaging in no more than 30-40 minutes of aerobic exercise three times a week. Subjects will be informed of their exclusion from the study if they have a history of cardiac health problems or hypertension.

Procedures: This study requires 20-30 subjects, ages 20-39, to be used in a five-week study of the effects of t’ai chi chih on balance, and blood pressure. Subjects will be randomly assigned to either a t’ai chi chih or walking group. Initially, all subjects will have their blood pressure tested, and their balance tested on the NeuroCom® Balance Master to determine baseline data. Then, the t’ai chi chih group will participate in 45-60 minute exercise sessions three times per week for five weeks. One session a week will be led by a certified t’ai chi chih instructor and the two remaining sessions will be led by the investigators with the assistance of a video. One of the investigators will lead the walking group, which will walk three times per week, approximately 45 minutes, for five weeks. At the end of the five weeks, both groups will repeat the balance master test and have their blood pressure tested. The t’ai chi chih session, walking, and testing will take place on the campus of the University of North Dakota. Data collected from the study will then be statistically analyzed to compare the two groups of subjects and relate those values to the norms.

Informed consent: Each subject will receive a consent form, which outlines the study and any potential risks. Once subjects have reviewed the consent form, investigators will be available to answer any questions. Written, informed consent will be obtained from all subjects. (see attached form)

Risk: Personal injury is always a risk with exercise, including t’ai chi chih. Risk of injury while performing t’ai chi chih is thought to be minimal in the population of this study. Subjects will be excluded if they have a history of cardiac health problems or hypertension. Subjects will be informed that termination of activity is possible at any time. Termination will not prejudice their future relationship with the Physical Therapy Department, School of Medicine and Health Sciences, or the University of North Dakota. The certified t’ai chi chih instructor or the investigators will be present during all exercise sessions. If personal injury occurs during an exercise class, subjects will be encouraged to seek medical assistance or if necessary a medical emergency team will be contacted. The subject or their third party payer will be responsible for paying for these services.

Compensation: Subjects will receive no monetary compensation for participating in this study. The customary charge for the t’ai chi chih course will be waived.
3. **BENEFITS:** (Describe the benefits to the individual or society.)

Stress and high blood pressure are often problems that university students and society in general, face and can become serious if not controlled properly. Problems with balance in this age group may not be functionally imitating, but may need improvements. This study will compare the affects that t'ai chi chih and walking have on balance, blood pressure. Several studies have been conducted to show the effects of t'ai chi chih on balance, blood pressure. However, many of these studies have focused on elderly subjects, where as this study will concentrate on college subjects.

Our subjects will obtain several benefits from participating in this study. All subjects may personally benefit from participation in this study by contributing to the furthering of knowledge in the health sciences. Those participating in the t'ai chi chih and walking groups may experience the benefits of improved balance and decreased blood pressure. Also, t'ai chi chih classes taken elsewhere require a certain fee, the subjects in this study will participate in the class for free.

4. **RISKS:** (Describe the risks to the subject and precautions that will be taken to minimize them. The concept of risk goes beyond physical risk and includes risks to the subject's dignity and self-respect, as well as psychological, emotional or behavioral risk. If data are collected which could prove harmful or embarrassing to the subject if associated with him or her, then describe the methods to be used to protect the confidentiality of data obtained, debriefing procedures, storage of data, how long date will be stored (must be a minimum of three years), final disposition of data, etc.)

Personal injury is always a risk with exercise, including t'ai chi chih. Risk of injury while performing t'ai chi chih is thought to be minimal in the population of this study. Subjects will be excluded if they have a history of cardiac health problems or hypertension. Subjects will be informed that termination of activity is possible at any time. Termination will not prejudice their future relationship with the Physical Therapy Department or the University of North Dakota. The certified t'ai chi chih instructor or the investigators will be present during all exercise sessions. If personal injury occurs during an exercise class, subjects will be encouraged to seek medical assistance, which the subject or their third party payer will be responsible for paying.

The reports and results of this study will be coded and will not include the subject's names or personal information. Any information that is obtained in connection with this study and that can be identified with the subjects will remain confidential. All data from this study will be retained in a locked office in the UND physical therapy department for three years following completion of this study. Only those associated with conducting the study and the department director will have access to this information. All data will be shredded at the end of the three-year period.

5. **CONSENT FORM:** Attach a copy of the CONSENT FORM to be signed by the subject (if applicable) and/or any statement to be read to the subject should be attached to this form. If no CONSENT FORM is to be used, document the procedures to be used to assure that infringement upon the subject's rights will not occur.

Describe where signed consent forms will be kept and for how long (must be a minimum of 3 years), including plans for final disposition or destruction.

All consent forms from this study will be retained in a locked office in the UND physical therapy department for three years following completion of this study. Only those associated with conducting the study and the department director will have access to this information. A copy of the consent form to be used is attached.
6. For FULL IRB REVIEW forward a signed original and fifteen (15) copies of this completed form, including fifteen (15) copies of the proposed consent form, questionnaires, examples of interview questions, etc. and any supporting documentation to the address below. An original and 19 copies are required for clinical medical projects. In cases where the proposed work is part of a proposal to a potential funding source, one copy of the completed proposal to the funding agency (agreement/contract if there is no proposal) must be attached to the completed Human Subjects Review Form if the proposal is non-clinical; 7 copies if the proposal is clinical medical. If the proposed work is being conducted for a pharmaceutical company, 7 copies of the company’s protocol must be provided.

Office of Research & Program Development
University of North Dakota
Grand Forks, North Dakota 58202-7134

On campus, mail to: Office of Research & Program Development, Box 7134, or drop it off at Room 105 Twamley Hall.

For EXEMPT or EXPEDITED REVIEW forward a signed original, including a copy of the consent form, questionnaires, examples of interview questions, etc. and any supporting documentation to one of the addresses above. In cases where the proposed work is part of a proposal to a potential funding source, one copy of the completed proposal to the funding agency (agreement/contract if there is no proposal) must be attached to the completed Human Subjects Review Form.

The policies and procedures on Use of Human Subjects of the University of North Dakota apply to all activities involving use of Human Subjects performed by personnel conducting such activities under the auspices of the University. No activities are to be initiated without prior review and approval as prescribed by the University's policies and procedures governing the use of human subjects.

SIGNATURES:

Principal Investigator __________________________ Date

Project Director or Student Adviser __________________________ Date

Training or Center Grant Director __________________________ Date

(Revised 2/2000)
STUDENT RESEARCHERS: As of June 4, 1997 (based on the recommendation of UND Legal Counsel) the University of North Dakota IRB is unable to approve your project unless the following "Student Consent to Release of Educational Record" is signed and included with your "Human Subjects Review Form."

STUDENT CONSENT TO RELEASE OF EDUCATIONAL RECORD

Pursuant to the Family Educational Rights and Privacy Act of 1974, I hereby consent to the Institutional Review Board's access to those portions of my educational record, which involve research that I wish to conduct under the Board's auspices. I understand that the Board may need to review my study data based on a question from a participant or under a random audit. The study to which this release pertains is T'ai Chi Chih and its effect on balance and blood pressure.

I understand that such information concerning my educational record will not be released except on the condition that the Institutional Review Board will not permit any other party to have access to such information without my written consent. I also understand that this policy will be explained to those persons requesting any educational information and that this release will be kept with the study documentation.

Date ________________________________ Signature of Student Researcher ________________________________

1Consent required by 20 U.S.C. 1232g.
APPENDIX B
Information and Consent Form

Title: *T'ai Chi Chih and its effects on balance and blood pressure.*

Sarah Williams, Jennifer Baumgartner and Anita Osland, physical therapy students at the University of North Dakota, invite you to participate in their study. The purpose of this study is to determine the effectiveness of t'ai chi chih in reducing blood pressure and stress, and improving balance. Only UND students, staff, or faculty 20-39 years of age who engage in no more than 30-40 minutes of aerobic exercise, per session, three times a week will be eligible to participate in this study.

Should you choose to participate, you will have your blood pressure tested, and your balance tested on the NeuroCom® Balance Master at the beginning and the end of the study. The Balance Master is a clinically accepted machine commonly used by physical therapists for assessment and balance training.

Subjects will be randomly assigned to either a t'ai chi chih or walking group. The t'ai chi chih group will participate in 45-60 minute exercise session three times a week for five weeks. A certified t'ai chi chih instructor will lead one session a week, and the two remaining sessions will be led by the investigators with the assistance of a video. The walking group will walk three times a week for approximately 45 minutes each session for six weeks, which will be led by one of the investigators. The t'ai chi chih, walking, and testing will take place on the campus of the University of North Dakota.

You may personally benefit from participation in this study by contributing to the furthering of knowledge in the health sciences. Also, those participating in the t'ai chi chih and walking groups may experience the benefits of improved balance and decreased stress and blood pressure. Finally, certified t'ai chi instruction will be free of charge.

You will receive no monetary compensation for participating in this study.

Personal injury is always a risk with exercise, including t'ai chi chih, however, the researchers of this study feel the risk of injury while performing t'ai chi chih is minimal. The certified t'ai chi chih instructor or investigators will be present during all exercise sessions to safeguard you against possible risks. Subjects with a history of cardiac health problems, or hypertension will be excluded. If personal injury occurs during an exercise class, you will be encouraged to seek medical attention. You or your third party payer must provide payment for any such treatment.

You may chose to discontinue the experiment at any time up until data collection is completed. Should you decide to discontinue or not participate, this will not prejudice your future relationship with the Physical Therapy Department, School of Medicine and Health Sciences, or the University of North Dakota.
Your identity will remain anonymous in any reports of the results of this study. Any information that is obtained in connection with this study and that can be identified with you will remain confidential. All data from this study will be coded and retained in a locked office in the UND physical therapy department for three years following completion of this study. At the end of the three-year period, all data will be shredded.

The investigators involved are available to answer any questions you have concerning this study. In addition, you are encouraged to ask any questions concerning this study that you may have in the future. Questions may be asked by calling Anita Osland at (701) 786-2716, Jennifer Baumgartner at (701) 772-0107, Sarah Williams at (701) 746-4218, or faculty advisor Beverly Johnson at (701) 777-3871. A copy of this consent form is available to all participants in this study.

ALL OF MY QUESTIONS HAVE BEEN ANSWERED AND I AM ENCOURAGED TO ASK ANY QUESTIONS THAT I MAY HAVE CONCERNING THIS STUDY IN THE FUTURE. MY SIGNATURE INDICATED THAT I HAVE READ THE ABOVE INFORMATION, AND I HAVE DECIDED TO PARTICIPATE IN THE RESEARCH PROJECT.

__________________________________________  ______________________________
Participant's signature  Date

__________________________________________  ______________________________
Witness  Date
RHYTHMIC WEIGHT SHIFT

The inability to control the movement of center of gravity (COG) over the base of support would result in decreased balance abilities. The Rhythmic Weight Shift test is designed to examine the subject’s ability to accelerate the COG to travel and to decelerate to change directions. Also, it examines the subject’s ability to modify the timing of COG to match the cursor as seen on the computer terminal. Right/left and backward/forward movements of COG are tested.

There are three assessment levels in all of the tests included in the NCBM. The researchers chose highest level, Assessment Level Three, because of the population of the subjects. The pace set by the cursor for this level is one second per transition. The subject must complete at least four out the six transitions for the computer to generate a valid score.

The parameters measured during the Rhythmic Weight Shift test include on-axis-velocity and directional control. The researchers chose to use directional control, because the results of the pilot study showed the researcher to be reliable only for directional control, not on-axis-velocity. Directional control compares the movement intended towards the endline to the amount of extraneous movement away from the endline. The following formula demonstrates how directional control is calculated.

\[
\frac{\text{(amount of intended movement)} - \text{(amount of extraneous movement)}}{\text{(amount of intended movement)}}
\]

This formula is expressed as a formula, and the perfect directional control score is 100%. The scores represent how smooth and straight the subject is able to move from one end to the other.
Looking at the directional control graph, the first bar shows the average COG control for right/left weight shifting, and the second bar shows the average COG control for the backward/forward weight shifting. The third bar represents the average COG control for both directions combined. If the subject's score is in the gray region of the graph, it would indicate an abnormal score.
REFERENCES


