



2001

The Effect of T'ai Chi Chih on Balance and Blood Pressure

Jennifer Baumgartner
University of North Dakota

[How does access to this work benefit you? Let us know!](#)

Follow this and additional works at: <https://commons.und.edu/pt-grad>



Part of the [Physical Therapy Commons](#)

Recommended Citation

Baumgartner, Jennifer, "The Effect of T'ai Chi Chih on Balance and Blood Pressure" (2001). *Physical Therapy Scholarly Projects*. 36.

<https://commons.und.edu/pt-grad/36>

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 und.common@library.und.edu.

THE EFFECT OF T'AI CHI CHIH
ON BALANCE AND BLOOD PRESSURE

by

Jennifer Susan Baumgartner
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

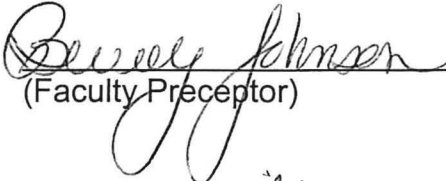
Master of Physical Therapy

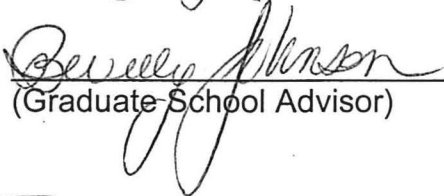


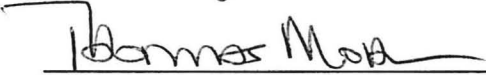
Grand Forks, North Dakota

May
2001

This Independent Study, submitted by Jennifer S. Baumgartner 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.


(Faculty Preceptor)


(Graduate School Advisor)


(Chairperson, Physical Therapy)

PERMISSION

Title The Effect of T'ai Chi Chih 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 that 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 Report of 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 Jennifer Baumgartner

Date 12/11/00

TABLE OF CONTENTS

LIST OF FIGURES	v
LIST OF TABLES	vi
ACKNOWLEDGMENTS	vii
ABSTRACT	ix
CHAPTER	
I INTRODUCTION	1
II LITERATURE REVIEW	4
Alternative and Complementary Medicine	4
Background and Philosophy of T'ai Chi	6
Benefits of T'ai Chi	10
Measurements Tested: Balance and Blood Pressure	15
III METHODS	19
IV RESULTS	27
V DISCUSSION AND CONCLUSION	32
APPENDICES	37
REFERENCES	50

LIST OF FIGURES

Figure		Page
1.	Yin/Yang symbol	7
2.	Movements of T'ai Chi Chih	8

LIST OF TABLES

Table		Page
1.	T'ai Chi Chih Group: Measurements and Paired Samples t-test Statistical Analysis.....	27
2.	T'ai Chi Chih Group: Measurements and Wilcoxin Signed Ranks Test Statistical Analysis	28
3.	Walking Group: Measurements and Paired Samples t-test Statistical Analysis	29

ACKNOWLEDGEMENTS

I would like to thank the individuals in my life who have helped me throughout the completion of this paper as well as in the completion of my physical therapy degree.

First of all, I would like to thank Beverly Johnson, my preceptor, for her enthusiasm and guidance through my research project as well as with the writing of my research paper. Her open mind and flexibility made her an appropriate guide for my alternative medicine topic. A special thanks also goes out to Renee Mabey for her assistance in statistical analysis.

Next, I would like to thank my research partners Sarah Williams and Anita Osland. I cherish my experience with them and the opportunity to work with two unique and creative individuals. Thanks to Anita for being a square and putting up with two squiggles.

My thanks also go out to those involved in our study including our T'ai Chi Chih instructor Heather Helgeson and the participants. Heather's peaceful spirit and knowledge of T'ai Chi Chih contributed immensely to the success of our study. We wouldn't have had a study without our participants and I thank them for their dedication and zeal.

Finally, I would like to thank my family. Thank you for supporting me in my quest for knowledge not only in school but also in life. The love that you have given me not only makes me secure in myself but also in my Heavenly

Father. With Him as my guide, may I use the knowledge that I have gained to bring comfort and healing to others.

ABSTRACT

The purpose of this study is to determine if T'ai Chi Chih could be beneficial in a therapeutic setting. More specifically, if balance and blood pressure could be improved in healthy young adults ages 20-39 after a six-week T'ai Chi Chih program. T'ai Chi Chih is a shorter form of the ancient martial art T'ai Chi Chuan.

Two research groups were formed consisting of a T'ai Chi Chih group (n=11) and a walking group (n=7). Each group participated in one hour of either walking or T'ai Chi Chih three times a week for six weeks. Participants were tested before and after intervention. Measurements tested included single-leg stance time, functional reach, rhythmic weight shift utilizing the Neurocom® Balance Master, and blood pressure via a standardized blood pressure machine.

Statistical analysis revealed a significant ($p < .05$) decrease in both systolic and diastolic blood pressure for the T'ai Chi Chih practitioners. Mean velocity of rhythmic shift left to right was also improved ($p = .078$) but not enough to deem significance. These findings support the use of T'ai Chi Chih as a therapeutic modality for patients with high blood pressure in conjunction with traditional treatment methods.

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.¹ 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 them as two separate systems.

Eastern philosophies and alternative medical practices, such as T'ai Chi Chih, are gradually entering and becoming more main stream in western culture. For hundreds of years Asian cultures have believed in the various forms of T'ai Chi and experienced the benefits of enhanced well being and health.² Even so, western culture has been slow to accept this practice because of our society's need for documentation and evidence based research before initiating the use of an unfamiliar activity such as T'ai Chi Chih.

Problem Statement

A limited research base has been built exploring the benefits of T'ai Chi practice in the elderly and those with various health concerns. The research to date has focused on the form of T'ai Chi known as T'ai Chi Chuan. This form consists of 108 movements requiring great dedication and practice for the practitioner to become proficient. A simpler form known as T'ai Chi Chih was developed with the goal of providing easily learned

movements that still offer the practitioner significant benefits. Additional research is needed to discover the therapeutic effects of T'ai Chi Chih. If T'ai Chi Chih is found to be beneficial to the healthy young population used in this study, it can be assumed 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 t'ai chi chih three times a week for six weeks.

Significance

Health care professionals in today's diverse society need to expand their practice to include a variety of activities and treatments to help patients reach their goals. Successful treatment will be more easily attained through a broad knowledge base of both traditional western treatments and alternative therapies. The more varied a therapist's treatment options, the greater the chance for successful treatment and recovery. Conventional treatments may work for most patients, but may have little or no effect on others. A physical therapist (PT) with a repertoire of traditional treatment options, supplemented by alternative therapies, will be more effective than a PT who doesn't accept more progressive methods.

This study will help determine if T'ai Chi Chih is effective in improving balance and/or decreasing blood pressure in healthy 20-39 year-old adults. If found to be effective in healthy young adults, T'ai Chi Chih can be

incorporated into the lifestyles of as well as the treatment of these individuals. Even greater improvements may be seen in individuals with physical limitations or debility.

Research questions

- 2.) What is the effect of a six week T'ai Chi Chih program on dynamic balance in subjects ages 20-39?
- 2.) What is the effect of a six week T'ai Chi Chih program on blood pressure in subjects ages 20-39?
- 3.) What is the effect of a six week T'ai Chi Chih program on static balance in subjects ages 20-39?
- 4.) What is the effect of a six week T'ai Chi Chih program on limits of stability in subjects ages 20-39?

Hypothesis

Hypothesis: A six week T'ai Chi Chih program will have no effect on dynamic balance, blood pressure, and/or limits of stability in subjects ages 20-39.

Alternate Hypothesis: A six week T'ai Chi Chih program will improve dynamic balance, decrease blood pressure and/or improve limits of stability in subjects ages 20-39.

CHAPTER II

LITERATURE REVIEW

Alternative and Complementary Medicine

Health care providers encounter patients with various injuries, disabilities and diseases. Each patient presents with a unique situation and responds to treatment differently. A wide array of interests, personal goals, stress levels and beliefs make up each individual. In order to provide the highest quality of care for every patient, it is important that we have a large variety of treatment options to accommodate every person. Traditional western medicine does offer an assortment of effective treatment options; however, they are only a small part of the spectrum of possible treatment techniques.

One way to expand our options is to look to our Eastern Asian neighbors and their rich supply of health remedies. In the United States, we refer to these eastern treatment techniques as unconventional, alternative, or complementary medicine techniques because they are different from our traditional western approaches. Unconventional techniques have been described as “medical interventions not taught widely at U.S. medical schools or generally available at U.S. hospitals.”³ The Alternative Medicine handbook states that “[complementary therapies] are generally noninvasive and helpful, pleasant and stress-reducing and applicable during sickness and

in health.”¹ The idea of a health care practitioner incorporating, or at least being aware of, different types of treatment is not for these techniques to become “alternative” techniques that replace traditional western medical care. Instead, it is hoped that the practitioner could incorporate some of eastern medicines methods into their current treatment base.

Eastern vs. Western Medicine

The main difference between Eastern and Western medical approaches is Eastern medicine’s focus is on the connection of mind and body. In the times of Hippocrates when western medicine was founded, this connection was recognized, but somewhere along the way western medicine has begun to view these as separate entities.⁴ “When confronted with disease, [western] medicine tends to look for a single, malfunctioning entity or disease causing agent and to develop a specialty to deal with it.”⁵ In eastern medicine the connection and balance between mind and body is essential to being healthy. With this as the focus, when disease presents a single problem is not identified but rather both the mind and body are explored to identify the source of imbalance.^{4,5} The basis of mind and body exercise is that “motor function cannot be separated from psychological processes, and by simultaneously training psychological and neuromuscular systems, one can meet psychological and physiologic demands more efficiently and appropriately.”⁶

Over the past several decades, Americans have become increasingly more interested in eastern medical practices and their benefits. A survey

conducted in 1993 reported that one in three respondents reported having used at least one unconventional therapy in the past year.³ Medical schools are also offering a variety of complementary or alternative medicine courses to their students. Wetzel,⁷ and his colleagues, conducted a survey which reported that 64% of the schools that replied offered elective courses in alternative or complementary medicine.

The eastern complementary therapy evaluated in this study will be the practice of T'ai Chi Chih as a therapeutic modality. All forms of T'ai Chi are based upon the same principles; therefore, other forms are also included in the literature review. The study will include the background and philosophy of T'ai Chi, previous research studies describing its benefits, a research study evaluating the effect of T'ai Chi on balance and blood pressure in healthy young adults, a discussion regarding the results of the study and T'ai Chi Chih's application to physical therapy.

Background and Philosophy of T'ai Chi

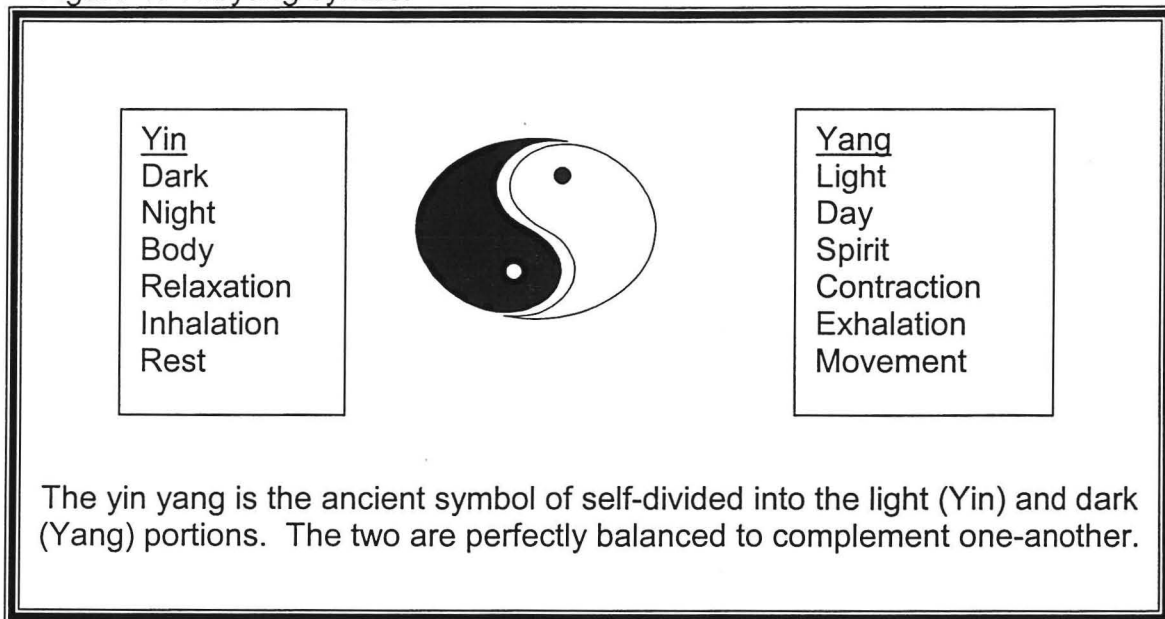
T'ai Chi, meaning "the ultimate," is a mind-body exercise that originated as a martial art in China 700 years ago.² In its original form, the movements of T'ai Chi were both rigid and soft, rapid and slow combining total body coordination and great mental control.² Lawrence Galante, an established T'ai Chi practitioner and author of *Tai Chi the Supreme Ultimate*, states, "for the body [T'ai Chi] is an exercise, for the mind it is a study in concentration, will power and visualization; for the soul, it is a system of spiritual meditation."⁸ It is this exercise of not only the physical body, but also the spirit and mind that enable t'ai chi to be successful.

The main principle behind the movements of t'ai chi and Taoist philosophy is the circulation of vital energy or "chi" throughout the body.⁴ The Chinese believe this energy runs throughout the body along 12 meridians or pathways. The gentle movements and controlled breathing of T'ai Chi exercise all the joints and major muscle groups while circulating the internal energy or "chi" allowing it to flow freely.^{9,10} Disease and debility are prevented through the unobstructed flow of chi.

The Chinese symbol for T'ai Chi is the Yin and Yang. In the eastern health philosophy, good health is a result of harmony between the Yin (negative) and Yang (positive) forces within the body.^{3,6} As described in *Complementary Therapies in Rehabilitation*,¹¹ the philosophy of the Yin and

Yang is fundamental to T'ai Chi and the Chinese understanding of health and sickness. The opposite colors of the yin-yang represent the opposing forces within the body. These must be equalized in order to have balanced chi, which is said to ward off potential illness, improve general health, and extend life.¹ Figure 1 describes the meaning behind this ancient Chinese symbol.

Figure 1. Yin/yang symbol

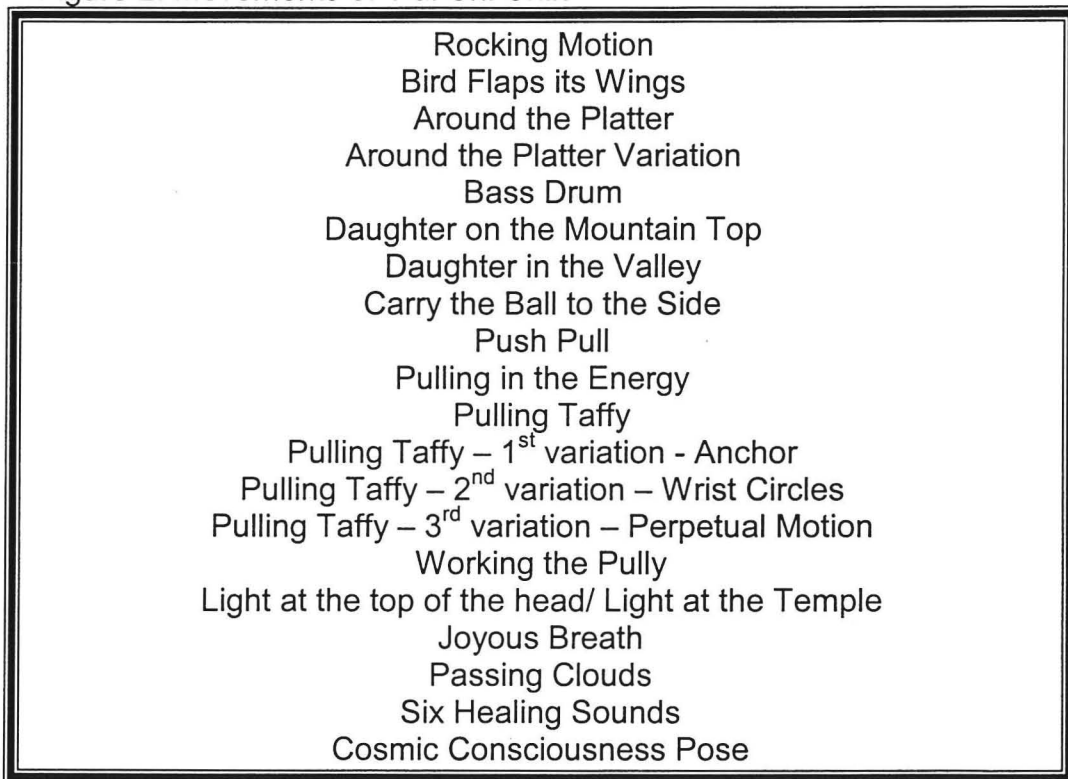


There are many different sub-types of T'ai Chi including short and long forms. T'ai Chi Chuan meaning "grand ultimate fist" was the original form of T'ai Chi. Developed in the 13th century by the monk, Cheng Sang Feng, of the Wu dynasty, T'ai Chi Chuan was created as a form of exercise and self-defense.² T'ai chi chuan consists of 108 movements. By the 19th century, several major styles and many minor forms of T'ai Chi developed. The three main schools that evolved are Chen, Yang, and Wu.⁸ Even though each form of T'ai Chi has variations in the expressions of postures and movements, the content and principles remain identical.⁴

T'ai Chi Chih

A simpler and shorter form of T'ai Chi called T'ai Chi Chih was developed in the early seventies by a man named Justine Stone.¹² Stone had practiced and taught T'ai Chi Chuan for many years prior to developing T'ai Chi Chih. His purpose in developing T'ai Chi Chih was to provide easily learned movements that afford the practitioner great benefits. T'ai Chi Chih consists of nineteen gentle, graceful movements and a pose (Figure 2). The movements are based on yin-yang principles and a few ideas from T'ai Chi Chuan.

Figure 2. Movements of T'ai Chi Chih



T'ai Chi Chih is done with the tailbone slightly pressed forward, the shoulders relaxed, and the hands and wrists moving in soft, circular

motions.¹² While practicing T'ai Chi Chih, the mind should be clear and concentration held on the soles of the feet or on the spot two inches below the naval. While T'ai Chi Chih can be done at any speed, slow gentle movements work best to circulate the chi. Breathing during T'ai Chi Chih should be natural. Consistent daily practice of at least 10-15 minutes in the morning and again in the late afternoon or early evening provides maximum benefits. For more specific descriptions as well as pictures of the movements, refer to Stone's book *Joy Through Movement*.¹²

The gentle nature of T'ai Chi creates no contraindications making it a great exercise for individuals with compromised health such as osteoarthritis, rheumatoid arthritis, heart problems, and the elderly.¹³⁻²⁵ Clinical research supports that t'ai chi has the following benefits: reduced blood pressure, improved range of motion, flexibility, strength and balance, decreased risk of falls, increased oxygen uptake and utilization, reduced levels of stress hormones before and after practice, improved immune function, and heightened mood status.^{1,9,13-15}

Benefits of T'ai Chi

The Chinese, and other Eastern cultures, have diligently practiced and experienced the benefits of T'ai Chi for hundreds of years.² However, according to today's research standards, additional scientific research is still needed to support its benefits. Initial research on T'ai Chi was taken from translation of the Chinese literature. In the last twenty years as the popularity of T'ai Chi has increased in America, so has the interest in exploring its benefits. Most research studies have concentrated on the elderly population and have used T'ai Chi Chuan as the intervention tool. The literature reviewed for the purpose of this section of the study has been limited to research of T'ai Chi's effects on balance, stress and blood pressure, rheumatoid arthritis and heart conditions, muscular strength and endurance and flexibility.

Balance

Schaller²² conducted a study using participants with an average age of 70 years who performed T'ai Chi Chuan for ten weeks. Significant improvements were found in single-limb stance time with eyes open by an average of 50% from pre-test to post-test mean.

Hong, Li and Robinson¹⁷ found that elderly males who had regularly practiced T'ai Chi Chuan for ten years or longer had better balance than a group of similarly aged sedentary males. The T'ai Chi Chuan group had significantly better scores in both right and left single-limb standing with eyes closed ($p < .05$).

The majority of the balance research is limited to the older population; however, a group of individuals from Northwestern medical school and the Rehabilitation institute of Chicago²⁴ conducted a study, which included subjects of multiple ages with mild balance disorders. Participants ages ranged from 20-76 years and older and were divided into three age groups (20-60 years, 61-75 years, and 76 years and older). Highly significant improvements were found on the posturography test for the youngest and oldest groups. The youngest group also had significant improvements in the Dizziness Handicap Inventory questionnaire scores. Improvements were also demonstrated on the Romberg test in the youngest and oldest groups, results however, were not significant at $p < .001$.

The Atlanta FICSIT (Frailty and Injuries: Cooperative Studies on Intervention Techniques) group along with Wolf, Barnhart, Kutner et al¹⁰ conducted a study evaluating the effects of T'ai Chi Chuan and computerized balance training on individuals 70 years of age and older. Intervention groups were separated into a computerized balance training group, a T'ai Chi group, and an educational group serving as a control for exercise. The risk of multiple falls in the T'ai Chi group was found to decrease by 47.5%.¹⁰

A second study by the Atlanta FICSIT group¹⁵ along with Wolf, Barnhart, Ellison and Coogler replicated the previous study comprising the same intervention groups and similar aged subjects. The computer balance training group revealed greater stability during platform balance tests; whereas, the T'ai Chi and educational group showed little change. In

addition, the results showed a trend where the T'ai Chi group was less afraid of falling after training compared to the other groups and delayed onset of first or multiple falls. The T'ai Chi group did not reveal improvements in postural stability, however the author did not substantiate the link between postural stability and functional balance.

Stress and Blood Pressure

Jin²⁶ analyzed the efficacy of T'ai Chi, brisk walking, meditation, and reading in reducing mental and emotional stress in a group of subjects ages 34-50. Individuals in all of the treatment conditions showed decreased stress, as measured by the decreased salivary cortisol level and improved mood states. The T'ai Chi group proved to be better than the neutral reading group for reduction of state anxiety and enhancement of vigour. This study also found that T'ai Chi has similar effects in heart rate, blood pressure, and urinary catecholamine changes to those walking at a speed of six km/hr.

Jin²³ conducted another study which compared the heart rate, noradrenaline, cortisol and mood of beginners and experienced T'ai Chi practitioners while performing t'ai chi chuan.²³ This study also supports growing evidence that T'ai Chi has cardiovascular effects similar to moderate exercise. While both groups showed improvements in all areas, the experienced T'ai Chi group, who had performed T'ai Chi for at least a year, had greater improvements than the beginning T'ai Chi practitioners. Young, Appel, Jee and Miller's study¹⁷ also demonstrated decreases in blood pressure following T'ai Chi equivalent to moderate-intensity aerobic exercise.

Rheumatoid arthritis and heart conditions

Many forms of exercise can have detrimental effects on individuals with a compromised health status. The slow, controlled movements of T'ai Chi however, provide gentle pain-free exercise for these individuals. T'ai Chi Chuan proved to be a safe form of exercise for patients with rheumatoid arthritis (RA).²⁰ The patients with RA showed no increase in arthritis symptoms when compared with the control group. The parameters tested included joint tenderness, joint swelling, time to walk 50 feet, handgrip strength, and a written functional assessment.

Channer¹⁸ conducted a study using subjects who had suffered a definite acute myocardial infarction. The subjects were randomly assigned to groups in T'ai Chi Chuan, aerobic exercise, or a cardiac support group. The T'ai Chi and aerobic exercise group both had significant decreases in systolic blood pressure; however, the T'ai Chi group was the only group that had significant decreases in diastolic blood pressure.

T'ai Chi also proved to be safe for low-risk patients who have had coronary artery bypass surgery and have completed phase II cardiac rehab.¹⁹ After one year of T'ai Chi training, individuals in this study showed significant improvements in cardio-pulmonary function. Cardiac improvements included VO₂ peak during peak exercise and an increase in work rate. Pulmonary function improvements included an increase in VO₂ and work rate. In contrast, the control group showed declines in all of these areas.

Hong, Li, and Robinson's study¹⁷ revealed the benefits of long-term t'ai chi practice. They found that their experienced t'ai chi group of elderly males had a significantly lower resting heart rate than the sedentary group ($p < .01$).

Muscular Strength and Endurance

T'ai Chi can also aid in gaining muscular strength and endurance as proved by a six month t'ai chi training program using individuals 50 years of age and older.²⁵ Strength was measured using the Cybex 6000 isokinetic dynamometer. Participants had significant improvements in concentric and eccentric peak torque and in knee extensor endurance ratio ($p < .05$).

Flexibility

Hong, Li, and Robinson's¹⁷ study concluded that participants had significant improvements for the modified sit and reach and total body rotation on both the right and left sides ($p < .01$). Total body rotation and the sit and reach test were performed according to the protocol provided by Hoeger and Hoeger using the Acuflex II.²⁷ The study also noted that the group of regular t'ai chi practitioners was in the 90th percentile rank for sit and reach test and total body rotation right and left as measured by the American Fitness Standards.¹⁷

Measurements tested: Balance and Blood Pressure

Balance

Balance is not a substantial problem for most healthy young adults. However, as individuals age it may become a problem that can lead to unnecessary injuries and bone fractures. Each year, 28% to 35% of individuals over the age of 65 and 40% of those over the age of 80 will suffer from a fall.^{28,29} Five to six percent of these falls result in bone fractures and ten percent result in soft tissue injury.^{30,31} Age related changes in the human body can lead to poor balance, which is the main risk factor for falls.

Balance defined by O'Sullivan and Schmitz³² is the stability produced on each side of a vertical axis. The central nervous system uses incoming and outgoing information to achieve proper balance. The incoming information derived from the sensory system includes the visual, somatosensory, and vestibular systems.

The visual system aids in maintaining balance by sending information to the brain regarding the orientation of the individual in reference to their surroundings.³² Somatosensory inputs help to provide relative orientation and movements of body parts in reference to the supporting surface. Orientation is acquired through the cutaneous sensation of the body in contact with the supporting surface as well as muscle and joint proprioceptors. The vestibular system helps orient a person to where they are in space. It detects angular and linear acceleration and deceleration forces acting and where the head is in regard to gravity.

In healthy young adults, functional balance is not usually a problem. It can be, however, if one of the three systems controlling balance is altered. Vision altered due to lighting or a physical problem may result in distorted balance. Distorted balance may also occur if somatosensory changes result such as individuals with altered cutaneous sensation. These alterations may occur as a result of a peripheral nerve injury, burns, diabetes, or any other condition that affects the ability to feel the standing surface. Balance deficits originating from the vestibular system can occur with damage to the inner ear. This may occur because of trauma, infection or age.

Elderly individuals have a higher incidence of falls due to the decreased acuity of many of essential elements of balance. Aging individuals experience a declination in their visual, somatosensory and vestibular systems. Decreased strength, proprioception, mental alertness, reaction time and flexibility may also contribute to increased falls in the elderly.

As previously stated, T'ai Chi can help improve balance and decrease the incidence of falls. It is a dynamic form of exercise that challenges the somatosensory, vestibular, and proprioceptive systems as well as strengthening the lower extremities.

Blood Pressure

High blood pressure, also called hypertension, is a significant problem in the United States today. An estimated 50 million Americans have high blood pressure which is 25% of all adults.³³ Many health problems are a direct result of hypertension. In fact, it contributes to 75% of all strokes and

heart attacks. High blood pressure can also result in damage to the heart, kidneys and eyes, bone loss, sexual dysfunction, mental deterioration, and complications during pregnancy.

Blood pressure refers to the force the blood produces against the arterial walls. The highest of these forces is the systolic pressure. This is the pressure generated when the left ventricle of the heart pushes blood through the aorta to supply blood to the periphery.²⁷ Diastolic pressure refers to the pressure when the ventricles are relaxed and the atria are filling. Blood pressure is categorized accordingly: 1) optimal blood pressure = 120/80 mm Hg (systolic/diastolic), 2) normal pressure = between 120/80 and 130/85 mm Hg, 3) normal high = 140/90 mm Hg.³³ Blood pressure above the classification for normal high (140/90 mm Hg) is considered hypertensive. The heart must work harder to pump the blood through the narrowed vessels, which may lead to injury or hypertrophy of the heart muscle. All vessels in the body can be affected by hypertension, but vessels of the kidney, brain and eyes are the most susceptible to injury.

Blood pressure is controlled by the following factors: peripheral resistance within the arterial system, pumping action of the heart, blood volume, viscosity of the blood, and the elasticity of the vessel walls.²⁷ Various factors may influence the blood pressure in an average healthy adult. Blood pressure will fluctuate throughout the day depending upon factors such as time of day, food consumption, emotional state, and strenuous activity. An

older or an obese individual will also have higher blood pressure than their younger or thinner counterparts.

With 50 million Americans being affected by high blood pressure, which may lead to greater health problems, it is obvious that a remedy is necessary. Hypertension is typically treated with anti-hypertensive medications.³³ Lifestyle changes such as a low-fat diet, regular exercise, limited caffeine, alcohol and smoking intake, good sleep habits, and stress reduction are recommended to decrease and prevent high blood pressure.³³ T'ai Chi can provide individuals regular exercise with the added benefits of stress reduction from its mind-body connection. The principles behind T'ai Chi and Taoist philosophy also encourage over-all good health including a proper diet and good sleep habits.

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. The components of the study were explained during the recruitment process to those interested in participating. The copy of the written informed consent form is located in Appendix B.

Subjects

Human subjects were needed to test the hypothesis for this study. Volunteers were recruited from the University of North Dakota through e-mail and the word of mouth, and involved 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 T'ai 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^R (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, which was needed to establish scores for the functional reach test. 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 inconsistencies.

Blood Pressure

Blood pressure was assessed before and after the intervention using a standardized blood pressure machine. Before the pre-test day and post-test day, the machine was calibrated by Altru Biomedical Resources. Each subject consistently had their blood pressure tested before 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 at both test sessions. (Significant amounts of either may cause an incorrectly high 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 .95.²²

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, they were said to have normal balance and 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 researcher kept the times with a stopwatch and averaged the trials for both eyes open and eyes closed which were 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 ninety 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.³⁴ It was selected by the researchers to measure and detect a possible change in balance before and after the intervention. As tested by Duncan^{34,35} et al, 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 their 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^R 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 sixty inch force platforms on top of four load cells that measure the force under each foot.³⁶ 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 Brouwer³⁷ conducted a study, comparing the NCBM to the Berg Balance Scale and to gait velocity, which showed the NCBM to be valid for the dynamic measures of balance only. According to the Balance Master

Manual,⁴⁸ 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 exists 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 begin testing.

Intervention

The 18 recruited subjects were randomly placed into two different groups. Group 1 (n=11) served as the T'ai Chi Chih group and participated in T'ai Chi Chih classes three days a week for 45 minutes each session. T'ai Chi Chih is a modified short form of T'ai Chi that was developed by Justin Stone.¹² He developed this form after finding that many students couldn't master the more

complicated form of T'ai Chi Chuan. T'ai Chi Chih consists of 19 repetitive movements and an ending pose that are simple and more adaptable to those students with some degree of physical or functional limitation.

One class a week was taught by a certified Tai Chi Chih instructor. This class was videotaped and made available for the subjects to check out if they were absent from a class or wanted to review the movements. The two remaining days of classes were led by the researchers, with the help of the video of the certified instructor. Participants were also encouraged to practice on their own time. 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=7) 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 T'ai Chi Chih group and the walking group was entered into the SPSStm software system. This program calculated the mean, standard deviation, mean difference and

standard deviation difference. 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 Master of Physical Therapy Program.

CHAPTER IV

RESULTS

Statistical Analysis

The Statistical Power for the Social Sciences (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-intervention (test 1) and post-intervention (test 2) 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. 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 1 and test 2 scores, and mean difference (test 2 score minus test 1 score) were computed for the T'ai Chi Chih group (table 1) and the walking group (table 3).

A significant decrease in systolic blood pressure ($p = .000$) and diastolic blood pressure ($p = .000$) was found, in the T'ai Chi Chih group, when comparing test 1 scores to test 2 scores. 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 1 scores to test 2 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 6 week walking program.

As stated in the methods, participants were required to attend T'ai Chi Chih classes three times a week or practice at home if absent. Attendance was taken before each class with the average number of T'ai Chi Chih sessions not performed being two per participant with a range of 0-4.

Table 1. T'ai Chi Chih Group: Measurements and Paired Samples t-test Statistical Analysis

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

* 000 < p = .05 indicating a significant difference

Table 2. T'ai Chi Chih Group: Measurements and Wilcoxin Signed Ranks Test Statistical Analysis

TEST	Test 1 M ± SD	Test 2 M ± SD	(Test 2-Test 1) M ± SD	n	z-score	p
R Single Leg Stance eyes open	106.61 ± 31.29	117.23 ± 7.43	-10.62 ± 25.39	10	-1.095	.273
L Single Leg Stance eyes open	114.23 ± 19.15	114.27 ± 19.00	- 4.55 ± .15	10	-1.000	.317
L Single Leg Stance eyes closed	31.56 ± 23.27	34.47 ± 33.60	- 2.91 ± 19.25	10	- .356	.722

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

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

* .005 < p = .05 indicating a significant difference

CHAPTER V

DISCUSSION

T'ai Chi Chih was found to be effective in decreasing both diastolic and systolic blood pressure in healthy adults ages 20-39. This finding correlates with the initial research hypothesis that participants will experience a significant increase in balance and/or decrease in blood pressure after performing T'ai Chi Chih three times a week for six weeks. The reduction in blood pressure after T'ai Chi practice coincides with previous research by Young and colleagues²¹ and Jin.²⁶ Young's study included populations of individuals ages 60 and over²¹ while Jin's study included individuals with an average age of mid to late thirties.²⁶

While studies using an older population have documented significant improvements in balance after the practice of T'ai Chi,^{15,17,22,24} this study did not find significant improvements. These findings are likely in concordance with the level of balance impairment before training. The younger population in this study had no balance limitations. Studies such as Hain and colleagues²⁴ have documented significantly improved balance when using younger individuals (20-60 yrs) with mild balance disorders.

The age group which this study includes is unique compared to many other research studies on T'ai Chi. Participants were fairly young and healthy having no balance problems, high blood pressure or other physical

limitations. Thus, any improvements are significant because they are in addition to what has already been deemed normal.

Even though much of the research supporting T'ai Chi praises its benefits for an older population, individuals of all ages and health status' can embrace T'ai Chi. A young person may choose to practice T'ai Chi for reduction of stress, as a low intensity form of exercise or for overall health. An older person may choose to do T'ai Chi for these same reasons and others including a decrease in falls, improved balance and coordination, strengthening, or a decrease in blood pressure. No matter the age of the practitioner, T'ai Chi can have profound benefits.

Limitations

Limitations of this study primarily revolve around the walking group. The sample size began with 11 participants and ended with five participants. Individuals who stopped their walking program chose to because of a lack of interest. Decreased compliance with exercise is often a challenge. Many of the individuals assigned to the walking group had hoped to be chosen for the T'ai Chi Chih group. Subsequent disappointment of not being able to do T'ai Chi Chih may have affected compliance.

Although this study found significant decreases in both systolic and diastolic blood pressure, the results may have been even greater had all of the subjects incorporated meditation into their practice of T'ai Chi. The participants were all T'ai Chi beginners, and by the end of the six week study, they were just becoming comfortable with all of the movements and their

sequence and most had not yet included significant meditation. Meditation is a key component that forms the mind-body connection of T'ai Chi.

While the physical gains of practicing T'ai Chi are immense, possibly the most astounding benefits will come from this mind-body connection. It is well known that today's society is bombarded with stress. In Miller and Smith's book *The Stress Solution* they state that 75-90% of all physician office visits are for stress-related ailments and complaints.³⁸ In fact, stress is linked to the six leading causes of death including heart disease, cancer, lung ailments, accidents, cirrhosis of the liver and suicide. This is an astounding fact that the very thing that is overcoming our society is in fact something we can prevent or at least reduce. Too often, when one thinks of becoming fit and healthy they condition their physical body, but fail to incorporate their mental health into the equation for total fitness and health. No matter how physically tuned a person's body may be, if their life and mind are encompassed by stress they will be far from obtaining optimum health.

The review of the literature in this study suggests that T'ai Chi has multiple health benefits. It has been shown to improve balance,^{17,22,24} muscular strength,²⁵ endurance,²⁵ flexibility,¹⁷ mood,²³ and cardiovascular status²³ as well as decrease fear of falling,¹⁵ stress²⁶ and blood pressure.^{21,26} It has also proven to be safe for individuals with compromised health status' such as those with rheumatoid arthritis, heart conditions and the elderly.

Physical Therapy and T'ai Chi

The scope of physical therapy encompasses treating patients with every one of the conditions listed above. Physical therapists could expand their current treatment repertoires for patients with these conditions to include T'ai Chi movements. A few select movements could be used to target certain movements desired to be included in therapy. The continual weight shifting forward, backward, and side-to-side mimic many of the pre-gait activities done with an individual with decreased balance, proprioception, or coordination. By adding the upper extremity movements and trunk rotation, the level of difficulty is increased further challenging the coordination of the patient. It is once the movements are mastered that the practitioner can begin to tune their mind while their body continues to reap the benefits of gentle physical exercise. The fact that T'ai Chi is so gentle and lacks contraindications makes it a great exercise for patients who cannot tolerate an aggressive physical workout. Individuals recovering from orthopedic injuries or cardiovascular problems as well as de-conditioned individuals, post-surgical patients, those with severe pain, chronic pain, joint restrictions or decreased mobility could benefit from T'ai Chi exercise.

This study supported T'ai Chi as an effective tool for reduction in blood pressure of healthy young adults. Previous studies have supported this finding as well as T'ai Chi's beneficial effect to the elderly and those with a compromised health status. The benefits obtained by T'ai Chi make it an appropriate treatment tool to be used in the scope of physical therapy

practice. Not only are the physical effects beneficial, but also the mind-body connection makes it a great exercise to help our patients deal with daily stress that can lead to further illness. In the words of an old Chinese prayer, "When you have a disease, do not try to cure it. Find your chi and you will be healed."³⁹

APPENDIX A

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

APPENDIX B

EXPEDITED REVIEW REQUESTED UNDER ITEM _____ (NUMBER[S]) OF HHS REGULATIONS
 EXEMPT REVIEW REQUESTED UNDER ITEM _____ (NUMBER[S]) OF HHS REGULATIONS

UNIVERSITY OF NORTH DAKOTA HUMAN SUBJECTS REVIEW FORM
FOR NEW PROJECTS OR PROCEDURAL REVISIONS TO APPROVED
PROJECTS INVOLVING HUMAN SUBJECTS

Please include ALL information and check ALL blanks that apply.

PRINCIPAL INVESTIGATOR: Beverly Johnson, Anita Osland, Sarah Williams, Jen Baumgartner TELEPHONE: 777-3821 DATE: 3/6/00

ADDRESS TO WHICH NOTICE OF APPROVAL SHOULD BE SENT: UND-PT P.O. Box 9037 Grand Forks, ND

SCHOOL/COLLEGE: Medicine DEPARTMENT: Physical Therapy PROPOSED PROJECT DATES: 4/3/00-5/5/00

PROJECT TITLE: T'ai Chi Chih and its effect on balance and blood pressure

FUNDING AGENCIES (IF APPLICABLE): _____

TYPE OF PROJECT (Check ALL that apply):

NEW PROJECT CONTINUATION RENEWAL DISSERTATION OR THESIS RESEARCH STUDENT RESEARCH PROJECT
 CHANGE IN PROCEDURE FOR A PREVIOUSLY APPROVED PROJECT

DISSERTATION/THESIS ADVISER, OR STUDENT ADVISER: Beverly Johnson PT, MS

PROPOSED PROJECT: INVOLVES NEW DRUGS (IND) INVOLVES NON-APPROVED USE OF DRUG INVOLVES A COOPERATING INSTITUTION

IF ANY OF YOUR SUBJECTS FALL IN ANY OF THE FOLLOWING CLASSIFICATION, PLEASE INDICATE THE CLASSIFICATION(S):

MINORS (<18 YEARS) PREGNANT WOMEN MENTALLY DISABLED FETUSES PERSONS WITH
 PRISONERS ABORTUSES UND STUDENTS (>18 YEARS)

IF YOUR PROJECT INVOLVES ANY HUMAN TISSUE, BODY FLUIDS, PATHOLOGICAL SPECIMENS, DONATED ORGANS, FETAL MATERIAL, OR PLACENTAL MATERIALS, CHECK HERE

IF YOUR PROJECT HAS BEEN/WILL BE SUBMITTED TO ANOTHER INSTITUTIONAL REVIEW BOARD(S), PLEASE LIST NAME OF BOARD(S): _____

Status: Submitted; Date _____ Approved; Date _____ Pending

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 RECORD¹

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

Consent required by 20 U.S.C. 1232g.

APPENDIX C

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

1. Cassileth BR. *The Alternative Medicine Handbook: The Complete Reference Guide to Alternative and Complementary Therapies*. New York, NY: W. W. Norton & Company; 1998:4-6,243-247.
2. Chen WCC. *Body Mechanics of Tai Chi Chuan*. New York, NY: William C C Chen; 1973.
3. Eisenberg DM, Kessler RC, Foster C, Norlock FE, Calkins DR, Delbanco TL. Unconventional medicine in the United States: prevalence, cost and patterns of use. *New Engl J Med*. 1993;328(4):246-252.
4. Kotsias JG. *Tai-chi tao for Physical Therapists: Applications and Interventions*. (Texas Ed.) Basic Movement and Reference Manual; 1996.
5. Wanning T. Healing and the mind/body arts: massage, acupuncture, yoga, t'ai chi, and feldenkrais. *American Association of Occupational Health Nurses*. 1993;41(7):349-351.
6. Ives JC, Sosnoff J. Beyond the mind-body exercise hype. *The Physician and Sportsmed* [serial online]. March 2000;28(3). Available from: The McGraw-Hill Companies. Accessed April 10, 2000.
7. Eisenberg DM, Kaptchuk TJ, Wetzel MS. Courses involving complementary and alternative medicine at US medical schools. *JAMA*. 1998;280(9):784-787.
8. Galante L. *Tai Chi The Supreme Ultimate*. York Beach, Me: Samuel

- Weiser, Inc; 1984.
9. Chuck H, Masley S. Tai Chi. [Academy of Tai Chi and Wu Shu Web site]. Available at: <http://www.taichiacademy.com/abouttaichi.com>. Accessed June 26, 2000.
 10. Wolf SL, Coogler C, Tingsen X. Exploring the basis for Tai Chi as a therapeutic exercise approach. *Arch Phys Med Rehabil.* 1997;78:886-91.
 11. Davis C, ed. *Complementary Therapies in Rehabilitation: Holistic Approaches for Prevention and Wellness.* Thorofare, NJ: SLACK Incorporated; 1996:133-156.
 12. Stone JF. *Joy Through Movement.* Fort Yates, ND: Good Karma Publishing Inc; 1997.
 13. Douglas B. *The Complete Idiot's Guide to: T'ai Chi & QiGong.* New York, NY: Alpha Books;1999:15,29.
 14. Lunmsden DB, Baccala A, Martire J. T'ai chi for osteoarthritis: an introduction for primary care physicians. *Geriatrics.* 1998;53(2):84,87-8.
 15. Wolf SL, Barnhart HX, Ellison GL, Coogler CE. The effect of Tai Chi Quan and computerized balance training on postural stability in older subjects. Atlanta FICSIT Group. Frailty and injuries: cooperative studies on intervention techniques. *Phys Ther.* 1997;77(4):371-81.
 16. Chen KM, Snyder M. A research-based use of Tai Chi/movement therapy as a nursing intervention. *J of Holistic Nurs.* 1999;17(3):267-77.
 17. Hong Y, Li JX, Robinson PD. Balance control, flexibility, and

- cardiorespiratory fitness among older Tai Chi practitioners. *Br J Sports Med.* 2000;34:29-34.
18. Channer KS, Barrow D, Barrow R, Osborne M, Ives G. Changes in hemodynamic parameters following Tai Chi Chuan and aerobic exercise in patients recovering from acute myocardial infarction. *Postgrad Med J.* 1996;72:349-351.
 19. Lan C, Chen S, Lai J, Wong M. The effect of Tai Chi on cardiorespiratory function in patients with coronary artery bypass surgery. *Med Sci in Sports Exerc.* 1999;31(5):634-638.
 20. Kirsteins A, Dietz F, Hwang S. Evaluating the safety and potential use of a weight bearing exercise, Tai-Chi Chuan, for rheumatoid arthritis patients. *Am J Phys Med Rehabil.* 1991;70(3):136-140.
 21. Young DR, Appel LJ, Jee S, Miller ER. The effects of aerobic exercise and T'ai Chi on blood pressure in older people: results of a randomized trial. *J Am Geriatrics Soc.* 1999;47(3):277-284.
 22. Schaller KJ. Tai Chi Chih: an exercise option for older adults. *J Gerontological Nurs.* 1996;22(10):12-17.
 23. Jin P. Changes in heart rate, noradrenaline, cortisol, and mood during Tai Chi. *J of Psychosomatic Res.* 1989;33(2):197-206.
 24. Hain TC, Fuller L, Weil L, Kotsias J. Effects of T'ai Chi on balance. *Arch Otolaryngol Head Neck Surg.* 1999;125:1191-1195.
 25. Lan C, Lai J, Chen S, Wong M. Tai Chi Chuan to improve muscular strength

- and endurance in elderly individuals: a pilot study. *Arch Phys Med Rehabil.* 2000;81:604-607.
26. Jin P. Efficacy of Tai Chi, brisk walking, meditation, and reading in reducing mental and emotional stress. *J Psychosom Res.* 1992;36(4):361-370.
27. Hoeger WWK, Hoeger SA. *Lifetime Physical Fitness and Wellness: A Personalized Program.* 3rd ed. Englewood, Colo: Morton Publishing Company; 1992.
28. Blake A, Morgan K, Bendall MJ, et al. Falls by elderly at home: prevalence and associated factors. *Age Ageing.* 1988;17:365-372.
29. Prudham D, Evans J. Factors associated with falls in the elderly. *Age Ageing.* 1981;10(3):141-146.
30. Gilbson MJ, Andres RO, Issacs B, Radebaugh T, Worm-Peterson J. The prevention of falls later in life. *Dan Med Bull.* 1987;34:1-24.
31. Tinetti ME, Speechley M, Ginter SF. Risk factors for falls among elderly persons living in the community. *N Engl J Med.* 1988;319(26):1701-1707.
32. O'Sullivan SB, Schmitz TJ. *Physical Rehabilitation: Assessment and Treatment.* 3rd ed. Philadelphia, Pa: F. A. Davis Company; 1994.
33. Simon H, Cannistra SA, Etkin MJ, et al. CBS Health Watch: Heart Health. Nidus Information Services Inc: Mar 2000. Available at:
[http://healthwatch.medscape.com/medscape ID=151048&Channel=11&ContentType=Library.](http://healthwatch.medscape.com/medscape_ID=151048&Channel=11&ContentType=Library)
34. Duncan PW, Weiner DK, Chandler J, Studenski S. Functional reach: a new

- clinical measure of balance. *J Gerontological Med Sci.* 1990;45(6):M192-197.
35. Duncan PW, Studenski S, Chandler J, Prescott B. Functional reach: predictive validity in a sample of elderly male veterans. *J Gerontol Med Sci.* 1992;47(3):M93-98.
36. Balance Master Manual. Clackamus, Ore: NeuroCom International; 1999.
37. Liston RAL, Brouwer B. Reliability and validity of measures obtained from stroke patients using the balance master. *Arch Phys Med Rehabil.* 1996;77:425-430.
38. Miller LH. *The Stress Solution.* American Psychological Association; 1997.
39. Marti JE, Hine A. *What is Alternative Medicine?* Detroit, Mich: Visible Ink Press; 1995.