The Strategies behind Dance Injury Prevention

by
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Abstract

The purpose of this study is to provide background information for the implementation of a dance injury prevention program. Surveys were developed to assess the need and desire for an instructional program. The need for a dance injury prevention program will be indicated by the number of dance-related injuries occurring on the properties of dance studios and the number of dance-related injuries treated at physical therapy clinics in the Middle Tennessee area. The desire for the instructional program will be based on the opinions of dance studio owners and clinic's lead physical therapist.

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Chapter 1

Background

Introduction

The professors of the Middle Tennessee State University Dance Department teach their students the importance of anatomical knowledge in a dancer's life. To become a safe and successful dancer, students need to understand how their bodies are made and how they move. Without proper knowledge of the body, dancers are risking serious injuries such as torn ligaments, sprained ankles, and dislocated joints. Unfortunately, due to the lack of an anatomy-based learning program during early dance education, many dance injuries occur early in a dancer's life. By the time dancers learn how important anatomical knowledge is to moving efficiency, they are in college and may already suffer from a previous dance injury.

Since starting dance in 2008, I have taken technique courses in ballet, tap, jazz, and pointe at a local dance studio. I started teaching ballet and tap to three to six year olds three years later. In 2011, I also began my study of dance at the university level in pursuit of a dance minor at MTSU. To complete the dance minor, I have taken courses in dance history, dance appreciation, Alexander Technique, and ballet, jazz, and modern technique courses. At the same time, I was also completing the prerequisites for physical therapy school which included anatomy and physiology, biology, chemistry, physics, and exercise physiology. I began to realize that I was applying the information from my anatomy and physiology class to my dance technique courses. The professors in the

dance program at MTSU encouraged me to explore the connection between anatomy and dance.

Dance Genres and Their Demands

Dance is known as living art in which men and women wear elaborate costumes and create complex formations. Few people outside of the world of dance realize the amount of work and dedication that is required to produce a dance concert. A dancer's dedication to his or her work is strong. Dancers spend hours working towards perfection of form, all the while attempting to make their movements enthralling, easy, and graceful. The demands of dance take a toll on a dancer's body.

There are many different genres of dance. For dance studios, certain genres are offered for different age groups. Ballet, tap, and jazz are the most popular dance genres offered for students under ten years old. Ballet, pointe, tap, jazz, lyrical, hip hop, and modern are usually offered for eleven to eighteen-year-old students. Pointe, lyrical, hip hop, and modern are offered to older dancers because these genres are more technique based. All dance genres use the same large muscle groups, such as the gluts, the quadriceps, the hamstring muscles, and the abdominal muscles. Yet each dance genre can require the use of small muscle groups for specific steps. Without proper stretching and warm-up before dancing, both acute and chronic injuries can occur.

Each dance genre has unique characteristics that use different types of muscle groups. Ballet is one of the oldest and most recognized genres of dance. Ballet has many characteristics; one of the most fundamental characteristic is the external rotation of the legs, also known as turnout. Pointe is a style of ballet that is danced on the tips of the

ballerina's toes. Dancing on pointe requires a specific shoe called a pointe shoe. Pointe shoes have a reinforced toe box that is flat on the tip, creating an even surface for the dancer to stand on.

Tap is the dance genre that can make its own music. Tap shoes have metal plates, called taps, on the ball and heel of the foot. The sounds produced by the taps can be altered by the amount of force a dancer uses and by the type of step being performed. Jazz is the dance genre usually seen on TV, in musicals, and on school dance teams. Isolations, leg splits, and high kicks are common characteristics in jazz dance and require the dancer to be flexible in the joints. Lyrical is a dance genre in which jazz and ballet are combined to create a soft and musical dance genre. Hip hop is a fast paced dance genre that requires a relaxed stance. Successful hip hop dancers have a sense of fluidity in their joints and muscles.

The rotation of the legs seen in ballet and pointe occurs at the hip joint and is made possible by six deep muscles: the obturator externus, the obturator internus, the piriformis, the gemellus superior, the gemellus inferior, and the quadratus femoris.[1] All six of these muscles connect the femur to the pelvis and are used to rotate the legs externally and internally. When teaching young children, one of the easiest ways to explain turnout is to use their feet as a visual guide. Using the feet as a visual guide to external rotation can lead a growing dancer to only turnout at their feet, an unnatural occurrence, and can lead to knee and ankle injuries. Pointe dancers need to have strong ankle muscles and good flexion in the ankles. If a student starts pointe work too early, bone structure can be compromised which can lead to serious injuries. Injuries in tap are

[1] Jacqui Greene Haas, *Dance Anatomy* (Champaign: Human Kinetics, 2010), 105.

usually related to dancing with too much force and can be seen in the feet and lower legs. Knee and hip injuries are common in ballet, jazz, and pointe due to the repetitive jumping and leg extensions. In jazz, injuries can occur when dancers attempt to force their bodies into the split position or force their legs into high kicks.

Injury Prevention

Dance related injuries can be either chronic or acute. Chronic injuries are developed over a period of time while acute injuries are instant injuries. Severe chronic injuries such as plantar fasciitis, patellar tendinitis, and stress fractures can develop from overuse, repetitive jumping and landing. Acute injuries such as cramps and ankle sprains can be the result of muscle fatigue, or unstable jump landings.[2] Both chronic and acute injuries can be limited by using injury prevention techniques.

One approach to injury prevention is preventive conditioning. "Preventive conditioning is concerned with obtaining a balance between strength, flexibility, and stamina."[3] Preventive conditioning can be incorporated into daily classes or taken as separate classes outside of the dance studio. In a jazz dance technique course I took at MTSU in the spring of 2014, our professor used the first twenty-five minutes of our hour and twenty-five minute class for warm-ups. Our warm-up routine included walking, jogging, and crunches in multiple directions. Our professor would mix up the routines every few weeks to work different muscle groups. Preventive conditioning can be

[2] Minda Goodman Kraines and Esther Pryor, Jump *into Jazz: The basics and beyond for the jazz dance student* (Boston: McGraw-Hill, 2005), 165.
[3] Daniel D. Arnheim, *Dance Injuries: Their Prevention and Care* (St. Louis: The C.V. Mosby Company, 1980), 11.

accomplished through cross training with yoga, Pilates, or any type of cardiorespiratory exercise.

Yoga can be beneficial to dancers for strength and endurance. "Dancers – no matter their style – who practice yoga stand to gain muscle strength, joint stability, and inner focus for their work."[4] Hatha yoga is the most common yoga style in the United States, and it "emphasizes breathing, balance, and flexibility."[5] Meg Brooker, an assistant professor in the Middle Tennessee State University dance program, is trained in hatha yoga and uses it in her classes. "[Meg] use[s] yogic principles to teach alignment cues such as internal and external rotation of the arms and legs, upper body alignment in inversions . . . curves of the spine for forward, lateral, backbending and twists . . ."[6] Yoga poses can be incorporated into the warm-up or cool down portions of a class, or yoga can be taken as an additional course on dance free days.

Pilates is a movement method that stretches and tones muscles. The Pilates method was developed by Joseph Pilates. The method was originally performed on an apparatus called the reformer. With or without the reformer, Pilates focuses on "strengthening the core muscles, correcting misalignments of the body, and providing a structural support for all movements."[7] The more common method today is performed on a floor or yoga mat. Performing Pilates on a mat makes the method more accessible to large classes of people.

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[4] Sarita Lou, "Yoga for Dancers: Poses that Build Strength + Focus," *Yoga Journal,* posted on March 24, 2015, http://www.yogajournal.com/slideshow/yoga-dancers-build-strength-focus/.
[5] Sandra Noll Hammond, *Ballet Basics* (Boston: McGraw-Hill, 2004), 110.
[6] Meg Brooker, in email interview with author, March 2015.
[7] Minda Goodman Kraines and Esther Pryor, Jump *into Jazz: The Basics and Beyond for the Jazz Dance Student* (Boston: McGraw-Hill, 2005), 49.

Cardiorespiratory exercises are focused on increasing the endurance of the heart (cardio) and lungs (respiratory). Cardiorespiratory fitness "allows for better transportation of oxygen and an increase in endurance levels. High cardiorespiratory endurance reduces physical and mental fatigue, which can also lead to injury."[8] Cardiorespiratory exercises are any type of exercise which increases heart rate and breathing rate, and can includes swimming, walking, jogging, and cycling. Dancers are encouraged to participate in cardiorespiratory exercises about three times a week.[9]

Tension held in the body causes the muscles to remain contracted which can lead to muscle fatigue and injuries. All of the "muscles have the capability of contracting, or creating tension, in various ways. Dynamic contraction is . . . any type of tension on a muscle where the length of the muscle changes . . . [creating] movement at the joint . . . isometric contraction means equal length – the muscle fires, creating tension, but there is no joint movement."[10] Tension can remain in the muscles after exercise and can be held in muscles for long periods of time. Massage, yoga, and the Alexander Technique are three methods that can be used to release tension in the muscles.

Massage can be used to prevent injuries as well as treat injuries. "Massage therapy may include exercises in breathing and in stretching and releasing."[11] Many dancers, including myself, use massage to stretch tight muscles before class and to ease sore or cramped muscles after class.

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[8] Jacqui Greene Haas, *Dance Anatomy* (Champaign: Human Kinetics, 2010), 9.
[9] Sandra Noll Hammond, *Ballet Basics* (Boston: McGraw-Hill, 2004), 111.
[10] Jacqui Greene Haas, *Dance Anatomy* (Champaign: Human Kinetics, 2010), 4.
[11] Sandra Noll Hammond, *Ballet Basics* (Boston: McGraw-Hill, 2004), 110.

The Alexander Technique is a movement practice that is used to alleviate tension held throughout the body. The Alexander Technique was developed by F. Matthias Alexander through a series of movement experimentations. The Alexander Technique is used to teach students how to move efficiently with a natural posture. There are no series of exercises such as in physical therapy or a dance warm-up. The Alexander Technique is an individually based technique that works on correcting an individual's posture through the individual's thoughts, not actions. Most Alexander Technique lessons occur between the instructor and one student. There are a few locations where Alexander Technique is taught to a group of students, such as in a university setting.[12]

Young children are visual learners; it is hard for them to understand what they cannot see. The simplest way to teach dance to children is to focus on the visual aspects of dance instead of the physiological aspects. For example, children are told to put their heels together and their toes apart instead of turning out using their hips. Meg Brooker stated in her interview that "young dance students are product rather than process oriented – they want to make extreme shapes with their bodies and may sacrifice good technique and alignment in order to achieve this external ideal."[13] As dancers grow, they continue to focus mainly on the visual beauty of dance which leaves them unaware of the physical risks of dance.

Dance Medicine

Dance medicine is a relatively recent field of study. Dance medicine is described as the practice of treating and preventing injuries caused by dance. There is no college-

[12] Marsha Barsky, in-class lecture, March 2015.
[13] Meg Brooker, in email interview to author, March 2015.

level education program in dance medicine, but there are a few physical therapy clinics offering dance medicine continuing education programs. These programs are currently being offered in New York, Massachusetts, Alabama, and Nashville, Tennessee. The programs offer educational seminars on or off the property.

Marathon Physical Therapy in Massachusetts has a Dance Medicine Outreach Program where therapists "guest lecture at studios around the Boston area, educating dance students, teachers and parents about injury prevention and healthy dance habits."[14] The Westside Dance Physical Therapy in New York offer an interdisciplinary program called the Dance Medicine Practicum. The program is composed of modules which "include lectures, demonstrations, hands-on lab sessions, case studies and live performances as well as skill and clinical reasoning assessments."[15] P3 physical therapy in Nashville offers educational programs to the Nashville community. These established dance medicine programs limit the exposure to dancers because they only offer programs near their facilities.

The establishment of a long distance educational program would reach a wider range of dance instructors and dancers. A long distance educational program would be convenient way to educate the public on dance injury prevention. The courses could be offered to dance teachers, dance students, or the parents of children involved in dance. The courses would be split into different sections, or modules, such as the spine, the core, the legs, and the arms. The courses could include exercises and principles from Pilates,

[14] "Dance Medicine," *Marathon Physical Therapy and Sports Medicine,* accessed on November 4, 2014, http://www.marathonphysicaltherapy.com/physical_therapy_dance_medicine.html.
[15] "Dance Medicine Practicum," *Westside Dance Physical Therapy,* accessed on October 24, 2014, http://westsidedancept.com/education/dance-medicine-practicum/.

yoga, cardiorespiratory exercises, the Alexander Technique, and physical therapy treatments. The courses could be taught by experts from each of the before mentioned techniques. Since many of the techniques require hands on training, an online only course would not be feasible.

The creation of an injury prevention instructional program geared towards K-12 dance instructors in the Middle Tennessee area will be beneficial. To provide background information for the implementation of such an educational program, surveys were developed to assess the need and desire for an instructional program. The need for the instructional program will be based on the number of dance-related injuries occurring on the properties of dance studios and the number of dance-related injuries treated at physical therapy clinics in the Middle Tennessee area. The desire for the instructional program will be based on the opinions of dance studio owners and clinic's lead physical therapists.

Chapter 2

Methods

The project included two surveys: a dance studio survey and a physical therapy survey. The surveys were created to analyze the need and desire for a dance injury prevention program in the Middle Tennessee area. The surveys were created using the author's knowledge of anatomy and dance. The participants for the survey were chosen from the yellow pages or Google and were addressed to the owners of each dance studio and the lead physical therapist at each clinic. The surveys were created in October 2014, and the participants were chosen at the time. The project was proposed to the University Honors College in November 2014, and was approved. The surveys and the survey process were reviewed and approved through expedited review by the MTSU Institutional Review Board in March 2015. The approval letter is in appendix A.

The dance studio survey requested data for the 2014-2015 school year and asked for the dance studio classification. The three classification choices given were: recreational, pre-professional, and professional. Recreational dance studios offer classes to all ages, with each student usually attending one or more single day classes each week for no more than seven hours. Pre-professional studios offer high intensity classes to older students in preparation for further study in dance. The students on the pre-professional track usually attend one or more multi-day classes a week, for over seven hours of dance in a week. Some pre-professional studios have a competition team which participates in local and national competitions. Professional studios train dancers for a career in dance. These studios are usually found in larger cities and have connections

with a dance company. By knowing the type of studio classification, the author is able to understand the physical pressure placed on the students and how committed the students are to studying dance.

The survey asked for the number of students enrolled at the dance studio, and how many students attended class more than two days a week. The survey also asked for the average number of hours each student spends in the studio each week. The survey asked for the number of anatomically specific dance related injuries that had occurred on the studio property. The next couple of questions asked about the instructors of the dance studio: how many part time and full time instructors the studio has and if those instructors were trained in any movement techniques. The two movement techniques listed were the Alexander Technique and the Laban Movement, and a blank option was provided for any additional movement type. The number of instructors employed by each studio will inform the author the number of potential participants of a dance injury prevention program. The full-time and part-time status of the instructors informs the author how accessible and time sensitive the injury prevention program needs to be.

The last two questions of the survey were opinion questions. The first opinion question asked the owner the likelihood of their encouraging their instructors to take a dance injury prevention course. The second opinion question asked how likely the owner would be to recommend their students to a physical therapist who specializes in dance injuries. Both questions used a modified Likert scale and included a space for explanation. The dance studio survey is in appendix B.

The dance studio survey was distributed to five participants in the Middle Tennessee area. The surveys were distributed to the owners of each dance studio in person by the author. For each potential participant, the author asked to speak with the dance studio owner or artistic director. The author then introduced herself and explained the idea behind the study and the survey. If the participant was willing to participate in the study, the author would have the participant complete the consent form. The participants were given a week to complete the survey. Two of the surveys were picked up in person, while three surveys were returned by mail, in envelopes provided by the author.

The physical therapy survey asked for information pertaining to the 2014 calendar year. The survey asked how many patients were treated for dance related injuries in the clinic. The next question asked the therapist to list the three most common dance related injuries they treated. The third question asked the therapist to list the percent of injuries caused by: lack of muscle strength, lack of flexibility, birth defects, muscle fatigue, and hyperextension. Muscle strength is the "amount of force that muscles need to produce movement as well as to halt or brake movement; to maintain a position, including correct body alignment; and to sustain repetitions of a given activity."[16] Flexibility is the "range of motion of a certain joint and its corresponding muscle groups."[17] Birth defects that are structural, such as scoliosis, can limit any type of physical activity. Muscle fatigue is "a reduction in muscle power output that can result from a decrease in both muscle force

[16] Sandra Noll Hammond, *Ballet Basics* (Boston: McGraw Hill, 2004), 106.
[17] Minda Goodman Kraines and Esther Pryor, *Jump into Jazz: The Basics and Beyond for the Jazz Dance Student* (Boston: McGraw Hill, 2005), 156.

generation and shortening velocity."[18] Hyperextension is an "excessive joint movement in which the angle formed by the bones of that joint is opened, or straightened, beyond its normal, healthy, range of motion."[19] The type of injury and the cause of the injury will tell the author how or if the injury can be prevented.

The survey also asked the age range of patients suffering from dance-related injuries. The question split the dancers in two different categories: recreational dancers, who danced less than seven hours a week, or pre-professional/professional dancers, who danced more than eight hours a week. The survey then asked if the therapist thought it would be beneficial to teach dance instructors in anatomy and kinesiology to help reduce dance related injuries, and for the therapist to explain their response. The final question of the survey asked the therapist to list three to five exercises they would use in their clinic to help prevent dance related injuries, and a brief description of the exercises. The physical therapy survey is in appendix C.

The physical therapy survey was distributed to six physical therapy clinics in the Middle Tennessee area. The surveys were administered to the lead physical therapist of each clinic in person by the author. For each potential participant, the author asked to speak with the lead physical therapist. The author then introduced herself and explained the idea behind the study and the survey. If the participant was willing to participate in the study, the author would have the participant complete the consent form. The participants were given a week to complete the survey. Four of the surveys were picked

[18] Scott K. Powers and Edward T. Howley, *Exercise Physiology: Theory and Application to Fitness and Performance* (New York: McGraw Hill, 2012), 173.
[19] "Hyperextension – Definition," *About Health*, posted on December 04, 2014, http://sportsmedicine.about.com/od/glossary/g/Hyperextension-Definition.htm.

up in person, while two surveys were returned by mail in envelopes provided by the author.

Once all eleven surveys were collected, the results were entered into an excel spreadsheet. One spreadsheet was created for the dance studio survey and a separate spreadsheet was created for the physical therapy survey. The numerical results from both surveys were used to create graphs. Non-numerical results were used to create lists and tables.

Chapter 3

Results

Dance Studio Survey Results

Of the five studios, two classified themselves as recreational studios, one was classified as a pre-professional studio, and the last two studios classified themselves as recreational and pre-professional. As explained in the methods section, recreational dance studios offer classes to all ages, with each student attending one class each week for no more than seven hours. Pre-professional studios offer high intensity classes to older students in preparation for further study in dance. The students along the pre-professional path usually attend multiple classes a week, for over seven hours of dance in a week.

The blue columns of Figure 1 show the number of students enrolled at each studio for the 2014 school year. The red columns of Figure 1 show the number of students that attend class two or more days each week for each studio. From the five studios, a total of 898 students are enrolled in a dance studio. Of the 898 students, 211 or 23.5%, attend classes two or more days each week. Of the students enrolled at dance studio 1, 32.5% attend class two or more days each week. Of the students enrolled at dance studio 2, 37% attend class two or more days each week. Of the students enrolled at dance studio 3, 32% attend class two or more days each week. Of the students enrolled at dance studio 4, 16.4% attend class two or more days each week. Of the students enrolled at dance studio 5, 20% attend class two or more days each week.

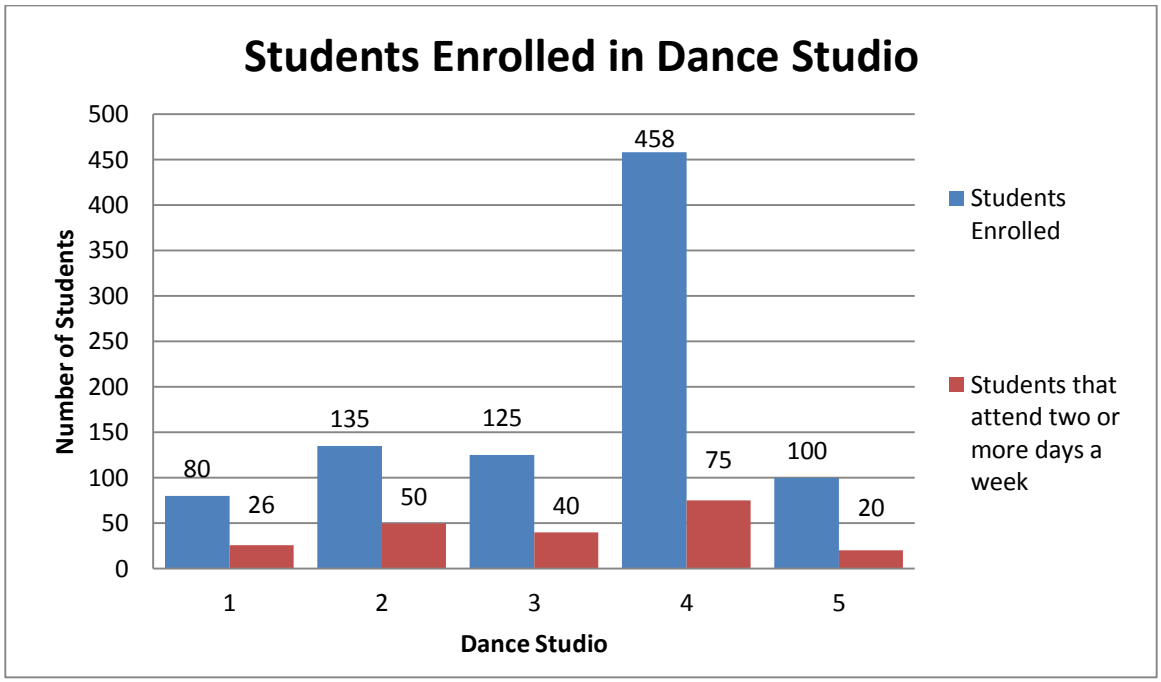

Figure 1: The number of students enrolled in each dance studio and the number of students who dance more two or more days a week.

Figure 2 shows the average number of hours each age group spends in dance classes each week. The data from dance studio 5 was removed because the only response provided was ten hours for the three to six year old age group. Dance studio 1 and 4 both meet the criteria for pre-professional studios because they both have students that dance seven or more hours a week. Dance studio 2 and 3 both meet the criteria for recreational studios because they both have students only dancing for less than seven hours a week. The average class time per week for three to six year olds is 1.5 hours. The average class time per week for seven to ten year olds is 2 hours. The average class time per week for eleven to fourteen year olds is 4.5 hours. The average class time per week for fifteen to eighteen year olds is 5.4 hours.

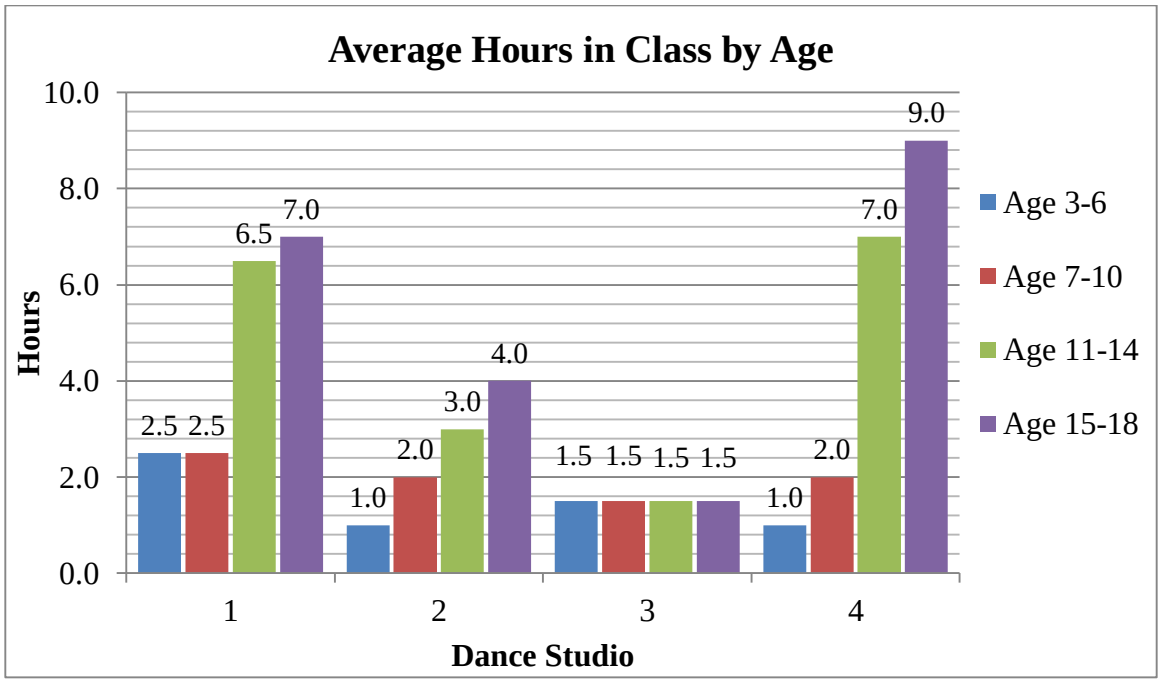

Figure 2: The average hours that each age group spends in dance class each week. Dance studio 5 data was removed due to an anomaly. Studio 1 and studio 4 meet the criteria for pre-professional.

Out of the 898 students enrolled in the studios, there were only four injuries that occurred on studio property. There were two foot injuries, two leg injuries, one torso injury, and one other injury in an unknown location. No additional information was requested about the injuries.

Figure 3 shows the number of full-time and part-time instructors employed by each studio. From the five dance studios, there are six full-time instructors and fourteen part-time instructors employed. The full-time and part-time status of the instructors informs the author how accessible and time sensitive the injury prevention program needs to be. Full-time instructors are able to dedicate more time to training, while part-time instructors may have to work around a second job or a home life. With the majority of the

survey instructors being part-time, an injury prevention program would have to be adaptable to a variety of schedules.

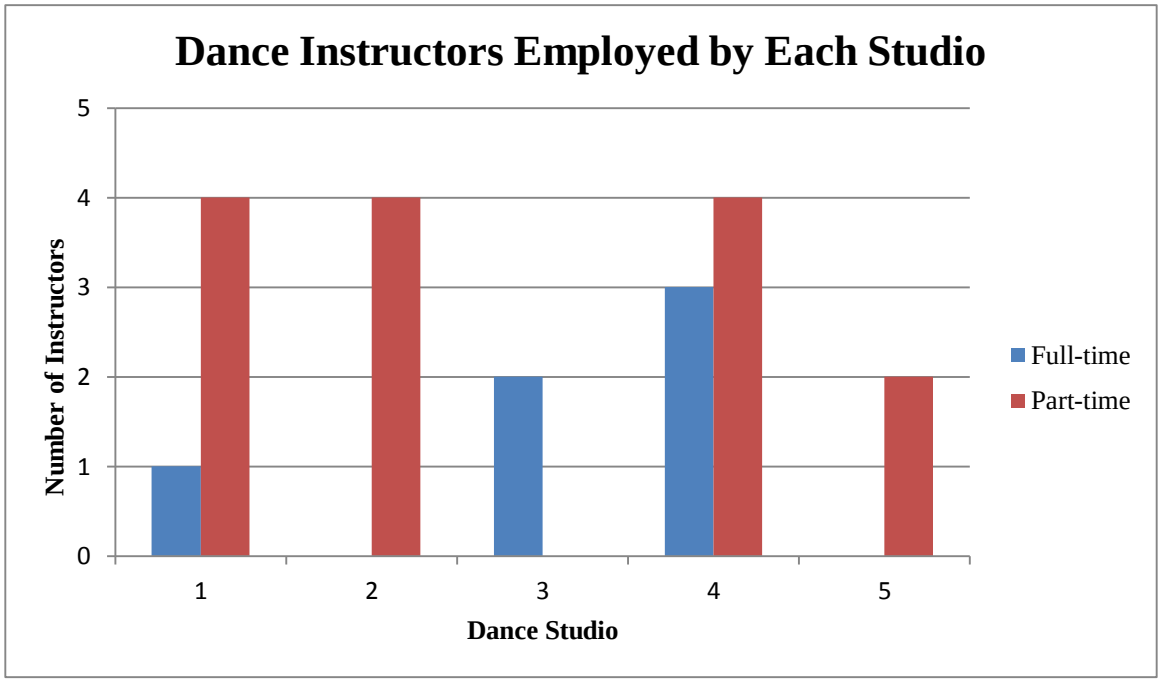

Figure 3: The number of full-time and part-time instructors employed by each studio.

Only three out of the five studios employed instructors that have been trained in a movement technique. Besides the Laban movement analysis, there were six other movement techniques listed on the surveys: the Chicago National Association of Dance Masters, the Horton technique, the Graham technique, the Vaganova method, the R.A.D., and the Cecchetti method. The six movement techniques were unfamiliar to the author thus a description of each method has been included.

- The Chicago National Association of Dance Masters is a "non-profit association whose purpose is to serve the continuing education and professional development needs of dance teacher."[20]
- The Horton Technique was developed by Lester Horton and is "based on Native American dances, anatomical studies and other movement influences."[21]
- The Graham Technique was established by Martha Graham. Its fundamental principles include "contraction and release, opposition, shift of weight and spirals."[22]
- The Vaganova method was developed by Agrippina Vaganova. The Vaganova method is a "technique which derived from the teaching methods of the old *Imperial Ballet School* . . . under the *Premier Maître de Ballet* Marius Petipa."[23]
- The R.A.D. stands for the Royal Academy of Dance which promotes the knowledge, understanding and practice of dance internationally . . . through promoting dance, educating and training students and teachers and providing examinations to set standards and reward achievement."[24]

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[20] "About Us," *Chicago National Association of Dance Masters,* accessed on April 26, 2015, http://www.cnadm.com/about-cnadm/.

[21] Joshua Legg, "Horton Technique," *DanceSpirit,* posted on April 15, 2009, http://www.dancespirit.com/how-to/modern/Horton_Technique/.

[22] Joshua Legg, "Graham Technique," *DanceSpirit,* posted on March 19, 2009, http://www.dancespirit.com/how-to/modern/graham_technique/.

[23] "Ballet Training Methods," *Russian Ballet History: Diaghilev's Ballets Russes 1901-1929,* accessed on April 26, 2015, http://www.russianballethistory.com/balletteachingmethods.htm.

[24] "About the Royal Academy of Dance," *The Royal Academy of Dance: United States,* accessed on April 26, 2015, https://www.radusa.org/about/.

- The Cecchetti method is a ballet technique developed by Enrico Cecchetti and is a "strict training system with special concern for anatomy within the confines of classical ballet technique, and seeks to develop the essential characteristics of dance in its students through a rigid training regime."[25]

Survey questions eight and nine were two-fold questions which use a modified Likert scale and an open ended response option. Question eight asks the dance studio owners the likelihood of their encouraging their instructors to take a course on dance injury prevention. The answers are represented by the blue columns in Figure 4. Three of the participants said very likely, one participant said likely, and one participant said neutral. Question nine asks the dance studio owners the likelihood of their recommending their students to a physical therapist who specializes in dance injury treatment and prevention. The answers are represented by the red columns in Figure 4. Four participants responded very likely while one participant responded likely.

[25] "Ballet Training Methods," *Russian Ballet History: Diaghilev's Ballets Russes 1901-1929,* accessed on April 26, 2015, http://www.russianballethistory.com/balletteachingmethods.htm.

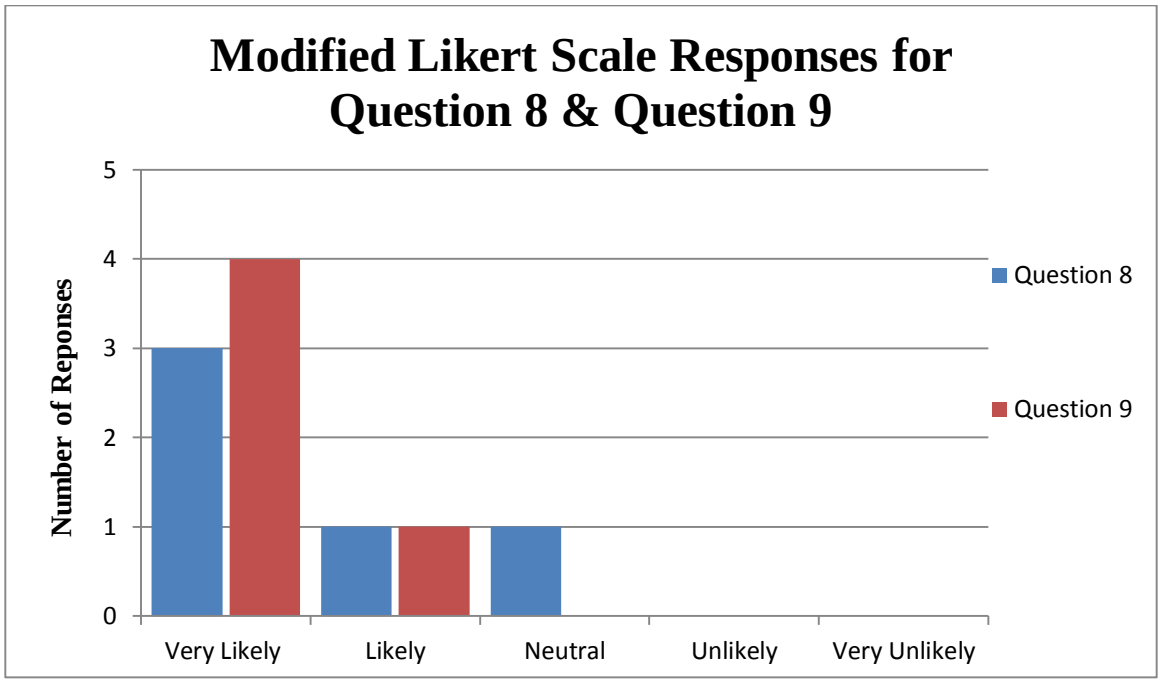

Figure 4: The responses from the modified Likert scale from question eight and nine on the dance studio survey.

Physical Therapy Survey Results

The survey from the first physical therapy clinic was removed from the study due to being returned with questions unanswered. The survey from the fifth physical therapy clinic was returned complete, but the clinic had not treated any patients with dance-related injuries. The lack of response from the fifth survey was relevant, but not included in all of the figures.

From four of the five Physical Therapy clinics surveyed, a total of twenty-one patients were treated for dance-related injuries in 2014. The fifth clinic did not treat any patients for dance-related injuries in 2014.

Figure 5 lists the three most common dance-related injuries for each physical therapy clinic. Each of the four clinics that treated dance-related injuries listed ankle

sprains as one of their three most common dance-related injuries. Posterior tibial tendonitis, plantar fasciitis, first metatarsophalangeal pain, and heel cord stiffness all affect the feet. Patellofemoral malalignment affects the knees, as well as the various knee injuries listed by physical therapy clinic 3 as meniscus tear and anterior cruciate ligament damage.

Clinic 2	Clinic 3	Clinic 4	Clinic 6
Posterior Tibial Tendonitis	Ankle Sprain	Fracture	Patellofemoral Malalignment
Plantar Fasciitis	Various Knee Injuries	Ankle Sprain	Inversion Ankle Sprain
Ankle Sprain	Hip Pathology	First Metatarsophalangeal Pain	Heel Cord Stiffness

Figure 5: A list of each clinic's three most common dance-related injuries, listed in order. Clinic 5 has no injuries listed because they did not treat any dance-related injuries in 2014.

Figure 6 shows the percentages of injuries caused by lack of muscle strength, lack of flexibility, birth defects, muscle fatigue, and hyperextension. As explained in the methods section, muscle strength is the "amount of force that muscles need to produce movement as well as to halt or brake movement; to maintain a position, including correct body alignment; and to sustain repetitions of a given activity."[26] Flexibility is the "range of motion of a certain joint and its corresponding muscle groups."[27] Birth defects that are structural, such as scoliosis, can limit any type of physical activity. Muscle fatigue is "a reduction in muscle power output that can result from a decrease in both muscle force

[26] Sandra Noll Hammond, *Ballet Basics* (Boston: McGraw Hill, 2004), 106.
[27] Minda Goodman Kraines and Esther Pryor, *Jump into Jazz: The Basics and Beyond for the Jazz Dance Student,* (Boston: McGraw Hill, 2005), 156.

generation and shortening velocity."[28] Hyperextension is an "excessive joint movement in which the angle formed by the bones of that joint is opened, or straightened, beyond its normal, healthy, range of motion."[29] From the four clinics that treated dance-related injury: 60.25% of injuries treated were caused by lack of muscle strength, 10% of the injuries were caused by lack of flexibility, 2.5% of the injuries were caused by birth defects, 37% of the injuries caused by muscle fatigue, and 15% of the injuries were caused by hyperextension.

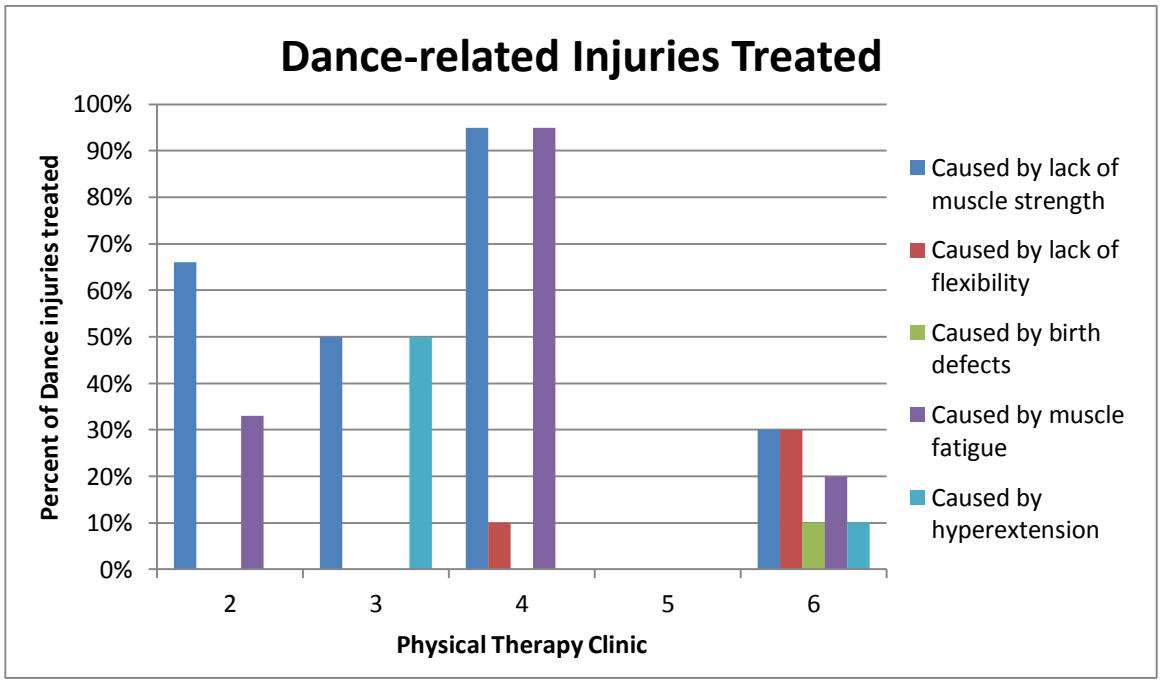

Figure 6: The percentage of treated dance-related injuries for each clinic.

[28] Scott K. Powers and Edward T. Howley, *Exercise Physiology: Theory and Application to Fitness and Performance,* (New York: McGraw Hill, 2012), 173.
[29] "Hyperextension – Definition," *About Health*, posted on December 04, 2014, http://sportsmedicine.about.com/od/glossary/g/Hyperextension-Definition.htm.

Figure 7 shows the age range of patients treated for dance-related injuries. The physical therapists at the clinic selected more than one age group. Two clinics treated patients in the seven to thirteen year old age range. Two clinics treated patients in the fourteen to eighteen year old age range. Three clinics treated patients in the 19 – 25 year old age range. One clinic treated patients in the 26 – 35 year old age range. The survey did not ask for the number of patients in each age range.

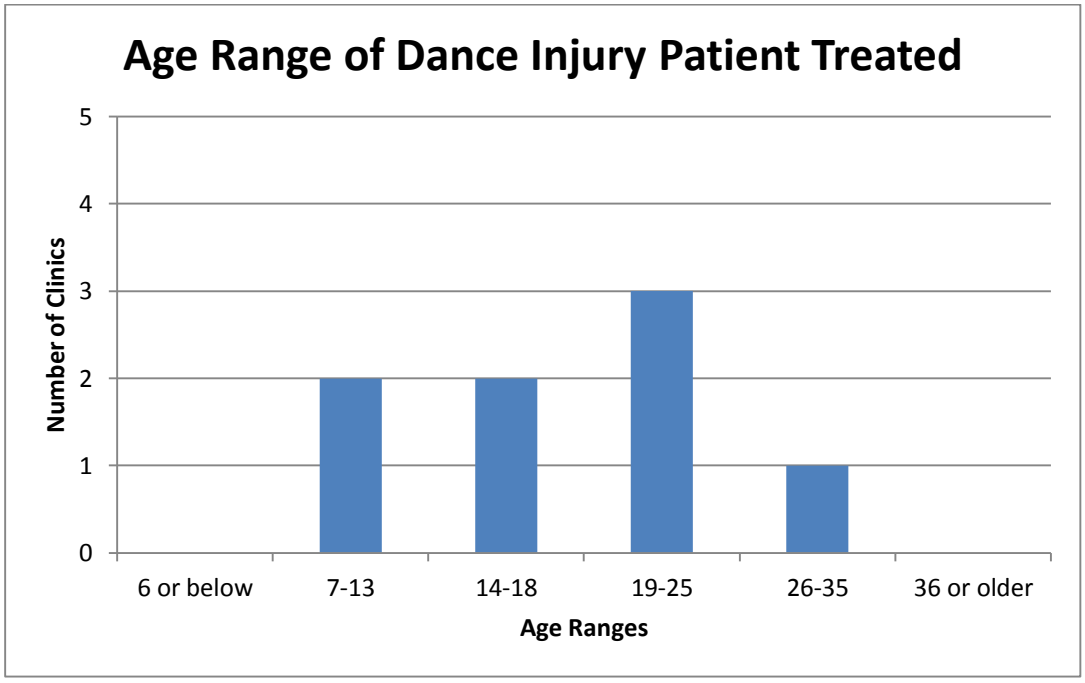

Figure 7: The age range of patient treated for dance-related injuries.

From the four clinics that treated dance-related injuries, all four agreed that it is beneficial to teach dance instructors in anatomy and kinesiology to help reduce dance-related injuries.

Figure 8 is a list of exercises that the physical therapists use in their clinics and that they would suggest to help prevent dance-related injuries. Clamshells are used to strengthen the rotation muscles, which would be beneficial for turn-out in ballet. The exercises from clinic 2 requiring an elastic band use resistance to build muscle strength. The balance exercises are beneficial to all dance genres, especially the genres with single leg turns.

Clinic 2	Clinic 3	Clinic 4	Clinic 6
Clamshells	Resist Knee Sidestep w/ Elastic	Clamshells	Single Leg Balance
Single Leg Dead Lift	AROM Stance Uni w/ Foam Eyes Open	Hip Abduction in Side Lying	Wall Squat
Oscillating Technique for Isometric Stabilization	Resist Ankle DF Longsit w/ Elastic	Balance/ Proprioception	Lunges
	Resist Ankle Ever Longsit w/ Elastic	Piriformis/Glute Stretch	
	Resist Ankle Inv Longsit w/ Elastic		

Figure 8: A list of exercises the physical therapist at each clinic would suggest to help prevent dance-related injuries.

Chapter 4

Conclusion

The surveys used in the study measured the need and desire for the implementation of a dance injury prevention program in the Middle Tennessee area. The level of need is determined by the number of injuries occurring on dance studio properties and the number of dance-related injuries treated at physical therapy clinics. If there are a high number of injuries, there would be a high level of need. Desire is determined by the number of positive responses to the opinion questions in both surveys.

According to the results, there is a low level of need for a dance injury prevention program in the Middle Tennessee area. From the five dance studios surveyed in the study, only four injuries occurred on studio property from 898 students enrolled in for the 2014-2015 school year. The on-property dance injury rate for all five studios is 0.45%. The four physical therapy clinics that treated dance-related injuries treated a total of 21 patients with the relevant injuries. There were more dance-related injuries treated than injuries occurring on dance studio properties. This abnormality can be due to the limited participation number, injuries occurring at off-property dance studio events or injuries occurring at school dance team activities.

The results show that there is a desire for an injury prevention program in the Middle Tennessee area. Four of the five dance studio owners surveyed replied positively to the question about encouraging instructors to be trained in dance injury prevention. All four physical therapists that treated dance-related injuries agreed that it would be beneficial to teach dance instructors in anatomy and kinesiology.

Study Improvements

The limiting portion of the study was the number of dance studios and physical therapy clinics the author was able to contact. Because the survey was conducted in late March and early April, many dance studios were preparing for spring recitals and were unable to meet with the author. If the survey was conducted in the summer or early fall, studio owners may be more willing to meet with the author. At many clinics, the lead physical therapists were too busy to meet with the author. The author believes that more participants would be willing to complete an online survey. An email could be sent to potential participants with a link directing them to a secure site to complete the survey.

Continued Research

For future research, the author would look at creating a survey geared towards middle and high school dance teams. The survey would be similar to the dance studio survey. It would ask how many students are on the dance team and how many of them take dance classes at a studio. The survey would ask the age of the dancers and how many hours a week the dancers practice. The survey would ask for the instructor's dance training. The survey would ask how many injuries occurred on and off school property, and whether the injury occurred during practice or games. The survey would ask if the instructor would be willing to take courses in dance injury prevention. The survey would determine if there is a need for a dance injury prevention program outside of dance studios.

Another area for future study would be a survey to find the best format for a dance injury prevention program. The survey would be distributed to dance instructors at

studios, universities, and schools. The survey would use the Likert scale to determine what areas the instructors are interested in studying. The choices would include cross-training techniques, muscle endurance exercises, how to recognize hyperextension, and many other techniques. The survey would also ask how much time instructors would be willing to dedicate to an injury prevention program. The survey would also ask if the instructors would be willing to travel to attend classes or if online classes would be more beneficial. The survey would lay the ground work for the creation of a dance injury program. Depending on the results of the survey, a trial program could be designed in an attempt to discover the cost of running a dance injury prevention program.

Appendix A

3/4/2015

Investigator(s): Nicole Braunwalder
Department: Communication Studies and ORCO
Investigator(s) Email: nlb3m@mtmail.mtsu.edu

Protocol Title: “Identification of strategies to reduce dance injuries”

Protocol Number: 15-189

Dear Investigator(s),

The MTSU Institutional Review Board, or a representative of the IRB, has reviewed the research proposal identified above. The MTSU IRB or its representative has determined that the study poses minimal risk to participants and qualifies for an expedited review under 45 CFR 46.110 and 21 CFR 56.110, and you have satisfactorily addressed all of the points brought up during the review.

Approval is granted for one (1) year from the date of this letter for 20 (TWENTY) participants.

Please note that any unanticipated harms to participants or adverse events must be reported to the Office of Compliance at (615) 494-8918. Any change to the protocol must be submitted to the IRB before implementing this change.

You will need to submit an end-of-project form to the Office of Compliance upon completion of your research located on the IRB website. Complete research means that you have finished collecting and analyzing data. **Should you not finish your research within the one (1) year period, you must submit a Progress Report and request a continuation prior to the expiration date.** Please allow time for review and requested revisions. Failure to submit a Progress Report and request for continuation will automatically result in cancellation of your research study. Therefore, you will not be able to use any data and/or collect any data. Your study expires **3/4/2016**.

According to MTSU Policy, a researcher is defined as anyone who works with data or has contact with participants. Anyone meeting this definition needs to be listed on the protocol and needs to complete the required training. **If you add researchers to an approved project, please forward an updated list of researchers to the Office of Compliance before they begin to work on the project.**

All research materials must be retained by the PI or faculty advisor (if the PI is a student) for at least three (3) years after study completion and then destroyed in a manner that maintains confidentiality and anonymity.

Sincerely,

Institutional Review Board
Middle Tennessee State University

Appendix B

Dance Studio Survey

This survey is to be administered to the owners or the artistic directors of the studio being surveyed. No identifiable information should be written on this survey. Please answer the questions using information gathered in 2014-2015 school year (August – Current Date) unless otherwise noted.

1. Is your studio a recreational, pre professional or professional studio? (Circle all that apply)

   (a) Recreational (b) Pre professional (c) Professional

2. How many students are enrolled in dance classes at your studio? _____

3. How many students attend dance classes two or more days a week? _____

4. For each age group listed below, please list the average number of hours each student spends in studio class each week.

   a. 3-6: _____
   b. 7-10: _____
   c. 11-14: _____
   d. 15-18: _____

5. For each category below, please list the number of dance related injuries that occurred in the current school year on the dance studio property.

   a. Foot injuries: _____
   b. Leg injuries: _____
   c. Torso injuries: _____
   d. Other (please explain):

      _____

6. How many full-time and part-time dance instructors are employed by your studio?
    a. Full-time instructors: _____
    b. Part-time instructors: _____
7. How many of your dance instructors are trained in movement techniques? *Please list any certification*
    a. Alexander Technique: _____
    b. Laban Movement: _____
    c. Other: _____
8. How likely are you to encourage your dance instructors to take courses on dance injury prevention?

    Very Likely Likely Neutral Unlikely Very Unlikely

    Please explain your answer:

    _____

    _____

9. How likely would you be to recommend your students to a physical therapist who specializes in dance injury treatment and prevention?

    Very Likely Likely Neutral Unlikely Very Unlikely

    Please explain your answer: _____

    _____

Appendix C

Physical Therapy Survey

This survey is to be administered to the lead physical therapist of the clinic being surveyed. No identifiable information should be included on this survey.

1. In 2014, how many patients were treated for dance related injuries in your clinic?

2. What are the three most common dance related injuries that the clinic has treated? Please list in order.
   (1) _____
   (2) _____
   (3) _____

3. Please list the percent of dance related injuries caused by the following issues.
   a. Injuries caused by lack of muscle strength _____
   b. Injuries caused by lack of flexibility _____
   c. Injuries caused by birth defects _____
   d. Injuries caused by muscle fatigue _____
   e. Injuries caused by hyperextension _____

4. Please list the age range for patients suffering from dance related injuries:

Recreational Dancers (Dances less than 7 hours a week)	Pre-professional/Professional Dancers (Dances more than 8 hours a week)
a. 6 or below	a. 6 or below
b. 7 – 13	b. 7 – 13
c. 14 – 18	c. 14 – 18
d. 19 – 25	d. 19 – 25
e. 26 – 35	e. 26 – 35
f. 33 and above	f. 33 and above

5. Would it be beneficial to teach dance instructors in anatomy and kinesiology to help reduce dance related injuries? Yes ☐ No ☐

   Please explain your response: _____

   _____

6. Please list a few exercises that you use in your clinic and would suggest to help prevent dance related injuries? (Please list 3-5 exercises and a brief description of the exercise)

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