THE EFFECT OF A TRADITONAL BALLET BARRE VERSUS A MODIFIED BALLET BARRE ON FLEXIBILITY, ANKLE STABILITY, AND ABDOMINAL STRENGTH & ENDURANCE IN COLLEGIATE DANCERS

An Undergraduate Research Scholars Thesis

by

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Submitted to the LAUNCH: Undergraduate Research office at
Texas A&M University
in partial fulfillment of requirements for the designation as an

UNDERGRADUATE RESEARCH SCHOLAR

Approved by
Faculty Research Advisor: Christine Bergeron, MFA

May 2021

Majors: Generalist Education[1]
Kinesiology – Dance Science Track[1, 2]

RESEARCH COMPLIANCE CERTIFICATION

Research activities involving the use of human subjects, vertebrate animals, and/or biohazards must be reviewed and approved by the appropriate Texas A&M University regulatory research committee (i.e., IRB, IACUC, IBC) before the activity can commence. This requirement applies to activities conducted at Texas A&M and to activities conducted at non-Texas A&M facilities or institutions. In both cases, students are responsible for working with the relevant Texas A&M research compliance program to ensure and document that all Texas A&M compliance obligations are met before the study begins.

We, Meghan Wehmeyer[1] and Carissa Weaver[2], certify that all research compliance requirements related to this Undergraduate Research Scholars thesis have been addressed with my Research Faculty Advisor prior to the collection of any data used in this final thesis submission.

This project required approval from the Texas A&M University Research Compliance & Biosafety office.

TAMU IRB #: 2020-0786D Approval Date: 09/10/2020 Expiration Date: 09/09/2021

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ABSTRACT

The Effect of a Traditional Ballet Barre Versus a Modified Ballet Barre on Flexibility, Ankle Stability, and Abdominal Strength & Endurance in Collegiate Dancers

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The knowledge of dance science has led towards prioritizing the physical and mental health of the dancer while still preserving the art's history. Previous research has revealed that safe practices in a dance class include a dynamic warm-up, less dependence on the barre itself, and withholding static stretching until the conclusion of the class. This study compared the effect of two different structures of ballet barre on the flexibility, ankle stability, and abdominal strength & endurance of collegiate dancers among three groups; traditional ballet barre (TBB), the dance science ballet barre (DScBB), and the control group. TBB (n=2) participated in a traditional ballet class which begins with plies, incorporates static stretching as part of the warm-up before dancers transition to centerwork, and using the ballet barre throughout the entire warm-up. DScBB (n=2) participated in a class taught based on dance science research including the absence of a ballet barre, a ballet specific dynamic warm-up, and withholding static stretching until the end of the class. Each class was taught once a week over Zoom for an 8-week period at a college intermediate level and maintained the same structure each week. Pre and post-

testing was completed to measure hamstring flexibility, ankle stability, and abdominal strength & endurance. The Modified Sit and Reach Test was used to evaluate the flexibility of the hamstring muscles, and The Plantar Flexion Repetition Test measured ankle stability. The Plank Hold Test and the FitnessGram Curl Up Test were used to measure the rectus abdominis and transverse abdominis endurance of the dancer. The results failed to reject the null hypothesis and were not statistically significant due to some restraints. There was a correlation between the DScBB and the abdominal strength & endurance of the dancers shown in the specific abdominal tests. Measured in the tests, the DScBB group's abdominal strength & endurance increased, while the TBB decreased. Future studies should be done to provide ballet teachers with a barre structure that prioritizes the dancer's physical health while preserving ballet's history.

ACKNOWLEDGEMENTS

Contributors

We would like to thank our faculty advisor, Christine Bergeron, MFA, for her guidance and support throughout the course of this research.

Thanks also go to our friends and colleagues and the department faculty and staff for making our time at Texas A&M University a great experience.

The Data analyzed for *The Effect of a Traditional Ballet Barre Versus a Modified Ballet Barre on Flexibility, Ankle Stability, and Abdominal Strength & Endurance in Collegiate Dancers* was provided by Christine Bergeron, MFA.

All other work conducted for the thesis was completed by the students independently.

Funding Sources

This work was also made possible in part by the Kay and Jerry Cox Undergraduate Scholars Program. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Kay and Jerry Cox Undergraduate Scholars Program.

NOMENCLATURE

DScBB	Dance Science Ballet Barre
TBB	Traditional Ballet Barre

1. INTRODUCTION

The growing knowledge of dance science has led to a shift towards prioritizing the mental and physical health of the dancer while still preserving its history. Previous dance science research has revealed that safe practices in a ballet class include a period of dynamic warm-up at the beginning, allowing less dependence on the barre itself throughout the class, and withholding static stretching until the conclusion of the class (Kozai, 2017; Lowery, 2014; Wilmerding, 2001). These findings oppose the structure of a traditional ballet barre which is centered around the aesthetics of movement and its connection to history.

Classical ballet is strongly influenced by the history on which it was established (Klapper, 2020). The structure of the training has changed slightly in different stylistic preferences but has remained very similar since its beginnings (Vaganova, 1969). The first ballet school opened in the late 1600s and codified many of the basic elements of a ballet class (Klapper, 2020). Klapper (2020) states that these principles are "equally familiar to a seventeenth-century French court dancer, an eighteenth-century Danish ballerina, a nineteenth-century Russian ballet student, a twentieth-century Chinese ballet company member, and a twenty-first-century American child taking a ballet class." Ballet was originally passed down through oral tradition until 1820 when ballet master, Carlo Blasis, published the outline of the ballet classes he taught in *An Elementary Treatise upon the Theory and Practice of the Art of Dancing* (Klapper, 2020). In this account, he explains the structure of this class starting with pliés (bending of the knees), moving to rond de jambe (a circular movement with the leg both on and off the ground), followed by grand battement (a beating action of the extended leg in motion) (Klapper, 2020). This pattern is started at an apparatus called the ballet barre and then

moved into the center of the room to be repeated before moving on to larger movements like turning, jumping, and "traveling", which is moving from one side of the room to the next. This structure that Blasis wrote about in the 1800s "would be familiar to ballet students across the world today" (Klapper, 2020). This order of the class has remained consistent over the course of classical ballet's existence and has not changed even with the new access to knowledge through research that there is access to in the twenty-first century.

The design of a ballet class was created based on the ability to teach young dancers each dance movement and using the earlier parts of the class to prepare for the latter half (Vaganova, 1969). Vaganova (1969) shows this when explaining that it is easier to teach correctness to a young dancer in elementary movements that happen at the beginning of a class. When they move towards combining movements and adding expectations of height, distance, and balance they will have a higher chance of success if they have already practiced the simpler skills (Klapper 2020; Vaganova, 1969). While the difficulty of each class level increases as the dancer gets older, this class structure that was established to teach young dancers remains consistent even for professional ballerinas. The second priority of the class is to prepare the dancer for the more complex movements that happen towards the end of the session. Vaganova (1969) explains one example of this in the battements tendu, which is an extension of the leg while keeping the toes on the ground. "The purpose of battements tendu is to produce a dependable and strong turn-out, so that later, during jumps, the feet will form themselves into a precise and correct position." (Vaganova, 1969). The order of each class was put together to prepare the dancer for the steps that were to come later in the class, but with the priority of proper technique, not the mental or physical needs of the dancer. This structure emphasizes systematic repetition for the perfection of the technique of each movement (Vaganova, 1969). Through the centuries-old structure of a

ballet class and the precedence of perfection in movement, the health of the individual dancer has never been a priority (Klapper, 2020). In contrast to this, the field of dance science is a new and growing field that prioritizes the overall health of the dancer leading to longer, injury-free careers. Both traditional ballet and dance science hold value in this art form but have not blended well together because of the foundational differences.

The modified dance science ballet barre class in this study focuses on three major changes which are founded in the research and adjusted to adapt this knowledge into a ballet class. The first change is the addition of a dynamic warm-up at the beginning of the ballet barre. A dynamic warm-up should take about 15 to 20 minutes and include four sections: a gentle pulse raise, joint mobilization, muscle lengthening, and a second pulse raise (Kozai, 2017). According to Kozai (2017), an effective warm-up will improve overall motor control, balance, coordination, and proprioception. These are all characteristics that are crucial to ballet technique. Kozai (2017) states that raising the pulse is a prerequisite for all further activity that will occur. This is a crucial element that is not being met in the current warm-up period of a traditional class. The design of a traditional ballet class assumes that the beginning ballet barre portion, lasting about 30 minutes, will warm-up the dancers enough for the second part of the class, but this is not the case (Kozai, 2017). The exercise participated in during the barre section has an equal amount of physical demand and should be preceded by a sufficient warm-up period. Adding a dynamic warm-up before class also reduces the risk of potential injury in the exercise that will follow (Kozai, 2017). Overall, the addition of a period of warm-up should aid the dancer's health in physical and mental preparation for the class that is to follow.

Another modification implemented in this study includes the withholding of static stretching until the end of the ballet barre class. Static stretching is defined as holding a stretched

position for 15 seconds or longer (Kozai, 2017). Static stretching before a period of exercise is shown to decrease the power of muscle performance (Lowery, 2014). This extra time spent in the stretch without being sufficiently warmed-up overrides the body's natural protection mechanism for muscles and joints and decreases muscle force (Kozai, 2017). This form of stretching has been shown to decrease the potential power used in the exercise, yet the structure of a traditional ballet class places it in the beginning and middle of the class (Vaganova, 1969). This placement is detrimental to the dancer because one of the most demanding sections of the class, requiring the body to have full power, is the jumping sections at the end of the class. If the power is being drained during participation of early static stretching, then the health and technique of the ballet dancer will be compromised, not allowing the dancer to reach their full potential. Dynamic stretching is recommended before working out in order to increase the body's temperature, increase joint mobility and help with mental readiness. Dynamic stretching is the action of moving through the full range of the joint in a continuous movement (Kozai, 2017). This dynamic stretching allows the muscles to lengthen and prepare for the necessary movement without disrupting the protective mechanisms or decreasing muscle force (Critchfield, 2012). Positioning static stretching at the end of the class will allow the muscles to benefit from the long stretch time without the known disadvantages that come before the dancer is warmed-up.

Lastly, the physical ballet barre has been removed from the structure of the dance science ballet barre intervention class. The use of a physical ballet barre has been shown to act as a crutch for the muscles being used to not fully reach complete activation (Martinell, 2009). The stability that is needed to complete ballet technique on a stage is not aided by the use of a ballet barre (Wilmerding, 2001). One example of this is found in the ballet action, développé devant. A développé devant consists of the dancer lifting one leg from the ground to bring their toes to the

knee of the opposite leg, then extending the leg out in front of them as high as possible while keeping their leg straight and their body and hips in neutral alignment. The leg that remains on the ground is called the standing leg and the leg executing the action is called the gesture leg (Vaganova, 1969; Wilmerding, 2001). Wilmerding (2001) used this position to compare if the position done at the ballet barre was an effective training for the muscular requirements of this position in the center portion of the class. She found that the muscular activation of the standing leg requires much more in the center than is ever fully reached when the action is performed at the barre (Wilmerding, 2001). When ballet is performed, it is done on a stage in the absence of any ballet barre. With the apparatus no longer available, the standing leg becomes a crucial part of the stability for the dancer as they are performing (Wilmerding, 2001). Wilmerding's (2001) study highlights the "limitations of using the barre for external support" and points to a transition that should be made to reduce the level of dependence on the apparatus for effective ballet training. This desired stability in ballet technique will be better aided by the removal of the ballet barre and should improve the muscular strength and health of the dancers themselves.

A type of dance that has been long-established, such as ballet, is not excluded from the needed transition prioritizing the health of dancers. Implementing dance science research into the classroom allows the next generation of dancers to continue celebrating the art while learning to prioritize their health. Putting the research into practice allows knowledge that has been gained to have practical use in each dancer's life. The purpose of this study is to combine the priorities from both traditional ballet and dance science in a way that preserves what is valuable from each field.

2. METHODS

This study consisted of 6 female college dance students (height = 165 cm $\pm$ 12.7 cm, weight = 63kg $\pm$ 18.8 kg) who were 20 to 22 years of age. Subjects participated in an 8-week intervention program that was part of a 10-week research analysis. For participants to be included in the study they had to be free from back, hip, ankle, and knee injury for the previous 6 months, enrolled in a university dance program, were not currently taking a ballet class, had reliable internet connection. Participants were excluded from the study if they had a lower extremity injury in the past 6 months, were not enrolled in a university dance program, were taking a ballet class or did not have access to internet. The study was approved by an IRB board and participants signed consent forms.

2.1 COVID-19 Protocol

This study was conducted during the COVID-19 pandemic, so protocol was followed in order to keep research personnel and participates safe throughout the study. Limited contact was used throughout the study and participants were from the same university dance program so no new contact was introduced between study participants.

2.1.1 Pre-Testing/ Post-Testing Protocol

Since pre and post testing were all conducted on the same day and in person the appointment times of the participants were staggered. One door was used to enter the studio used for testing and the other door was used to exit. Only one participant was allowed in the testing room at a time, and both participants and the researchers wore masks. The surfaces were wiped down with an approved disinfectant between each participant, and hand sanitization was used by both participants and researchers before and after each testing session.

2.1.2 Pre-Testing/Post-Testing Examination Selections

The tests selected to be used to measure flexibility, ankle stability, and abdominal strength & endurance in the participants were carefully selected both based on accuracy and how adaptable they would be to perform virtually. Pre and Post Testing protocol was adaptable to be conducted on a Zoom Video Conference if more restrictions were implemented during the study which would not allow in person contact. Even though this plan was in place, all pre and post testing sessions was able to be held in person.

2.1.3 Intervention Protocol

All intervention was conducted over Zoom to limit the possible exposure to COVID-19. This also allowed participants to continue to participate if they were quarantined due to a possible exposure.

2.2 Week 1: Pre-Testing

The participants attended one 30-minute pre-testing session that included a warm-up and evaluations of the participants' beginning flexibility, ankle stability, and abdominal strength & endurance. These qualities were tested using the Modified Sit and Reach test, the Plantar Flexion Repetition test, the Plank Hold test, and the FitnessGram Curl Up test. All these tests were monitored closely by the investigators to ensure the proper alignment that is described in each of the testing sections below. The pre-test was completed in person following the COVID-19 protocol.

2.2.1 Warm-Up

The warm-up included:

- Forward jog and back jog - Participants jogged from one side of the room down 20' and then back to where they started. (reps:1)

- Skipping - Participants skipped from one side of the room down 20’ and then back to where they started. (reps: 1)
- Alternating Front Leg Kicks - Participants kicked their right leg forward while extending their left arm to the front. They then switched and repeated with the left leg and right arm, continuing to rotate sides from one side of the room down 20’ and then back to where they started. (reps: 1)
- Walking Arabesque - Participants extended their right arm forward and their right leg back. They then switched and repeated on their left side, continuing to rotate sides from one side of the room down 20’ and then back to where they started. (reps: 1)
- Walking Lunge with Torso Twist - Participants lunged with their right leg forward while reaching their left elbow to touch their right knee. They then switched and repeated with the left leg and right arm, continuing to rotate sides from one side of the room down 20’ and then back to where they started. (reps: 1)
- Relevé Walks - Participants stepped onto a flat foot slowly doing a relevé (a rise to the ball of the foot) and then lowering back down to a flat foot. They then repeated on the opposite foot, continuing to switch feet from one side of the room down 20’ and then back to where they started. (reps: 1)
- Inchworm - Participants started standing and rolled down placing their hands on the ground. They then walked their hands out until they were in a plank position. Once in the plank they walked their feet towards their hands and rolled back up to standing to complete the first repetition. (reps: 10)
- Mountain Climbers - Participants started in a plank position and brought their right knee toward the chest and then placed it back in its starting position. They then repeated

bringing their left leg up to their chest and placing it back in its starting position to complete the first set of repetitions. (reps: 10)

2.2.2 The Modified Sit and Reach Test

The Modified Sit and Reach Test (Jackson & Baker, 1986) measures hamstring and lower back flexibility. The dancer sat with their head and back against a wall with their legs fully extended in front of them with their feet against a box. The dancer then extended their arms fully in front of them. The meter stick was placed with the zero mark at the tip of their fingers. The dancer then slid their hands forward along the meter stick as far as possible and the distance was recorded.

2.2.3 The Plantar Flexion Repetition Test

The Plantar Flexion Repetition Test (Lunsford & Perry, 1995) measures ankle strength and endurance. The dancer stood in parallel holding onto the ballet barre. The foot not being tested was lifted into a parallel coupé (foot held in place slightly above the opposite ankle). The dancer performed a relevé (rise on to the ball of their foot) on the standing leg and then lowered the leg. This was repeated until the dancer could no longer achieve their full range of motion in the ankle or they deviate from proper alignment of the ankle and foot by pronating, supinating, inverting, or everting.

2.2.4 The Plank Hold Test

The Plank Hold Test (Strand, Shoepe, & Fajardo, 2014) measures rectus abdominis and transverse abdominis strength. The dancer's elbows and forearms were firmly against the ground supporting their upper body off the ground. The dancer lifted their legs and hips up off the ground and support their lower body with the bottom of their toes. The dancer's body was a straight line from head to toe with the dancer looking down at the. The time started when the

dancer was in position and stopped when the dancer could no longer hold the plank with proper alignment including arching of the back, collapsed shoulders, head dropping below the shoulders, and the pelvis not being in line with the shoulder.

2.2.5 The FitnessGram Curl Up Test

The FitnessGram Curl Up Test (Plowman & Meredith, 2013) measures the rectus abdominis and transverse abdominis strength and endurance. The dancer laid on the floor on their back with their knees bent and the soles of their feet flat on the floor. The dancer placed their arms parallel to the floor with their palms facing down. The dancer performed a curl up, keeping their feet firmly against the ground, their fingertips reaching a mark on the floor 4.5 inches from their beginning position, and keeping to the rhythm of the recording. The test continued until the dancer could no longer keep the proper alignment or timing that is described above.

2.3 Week 2-9: Intervention

For the intervention participants were randomly split up into three groups: the Traditional Ballet Barre (TBB), the Dance Science Ballet Barre (DScBB), and The Control Group (CG). The intervention groups met once a week for approximately 45 minutes over Zoom Video Conferencing. Due to the COVID-19 pandemic, class was instructed through the Zoom online format.

The combinations varied from week to week, but the difficulty level was consistent for between the TBB and DScBB groups. The structure of the TBB and DScBB differed three ways; how the participants used the ballet barre, the use of a dynamic warm-up, and where static stretching occurred within the barre class. The two investigators rotated each week, either

instructing the ballet classes or watching the video feeds to give verbal corrections to the dancers on their timing and alignment.

2.3.1 Warm-Up – DScBB

The DScBB performed a warm-up before each class. During the dynamic warm-up participants rolled through their feet, circled their arms forward and backwards, rolled down to plank walking feet in and rolling back up twice, pranced around the room, and did grand port de bras. Each exercise was done for two eight counts and the whole process was repeated two times through.

2.3.2 Static Stretching – DScBB and TBB

For the stretching part of each class, participants started with their left hand on the barre and right foot on the barre. They bent their torso forward toward the leg and held for 30 seconds and then extend their torso back holding for 15 seconds. Then they shifted to where their foot on the barre was to their side and bent their torso toward their leg holding for 30 seconds and away from their leg holding for 30 seconds. Finally, the participants moved their leg on the barre to behind them and extended their torso back towards their leg for 15 seconds and bend their torso forward holding for 30 seconds. This entire process was repeated twice through on both the right and left leg. The exact same stretching combination that was performed in both the DScBB and TBB groups.

2.3.3 Traditional Ballet Barre (TBB)

The TBB class consisted of combinations and a structure that were similar to a traditional ballet class. This included remaining at the ballet barre throughout the warm-up, with a period of static stretching in the middle of the barre exercises while remaining at the ballet barre. The TBB classes followed this structure each week:

- Pliés
- Tendu
- Dégagé
- Rond de jambe
- Frappé
- Barre Static Stretching
- Développé / Fondu
- Grand Battement

2.3.4 Dance Science Ballet Barre (DScBB)

The DScBB class started with a dynamic warm-up, performed ballet combinations without the use of the ballet barre, and concluding with a period of static stretching. The warm-up and the end of class stretching done in the were the same each week. The DScBB group followed this class structure each week:

- Dynamic Warm-Up
- Pliés
- Tendu/Dégagé
- Rond de jambe
- Frappé
- Développé / Fondu
- Grand Battement
- Stretching

2.3.5 Control Group (CG)

The CG group did not receive any intervention and continued their regular routine.

2.4 Week 10: Post Testing

Post testing was completed in-person following COVID protocol and immediately following the 8 weeks of intervention. The subjects participated in the same guided warm-up that was administered before pre-testing and then completed the four tests described in the pre-testing section.

3. RESULTS

After collecting and analyzing the data from the pre and post testing we chose to look specifically at the root mean for each of the three groups in each of the tests. We calculated the p value for each test, but the small number of participants led to insignificant data and skewed p values.

3.1 Flexibility

Flexibility was measured using the sit and reach test. Flexibility increased in the TBB with an average increase of 1.745 inches. The Control group's average reach increased by an average of 0.585 inches, meaning that their flexibility increased as well without an intervention plan. However, the DScBB group's flexibility decreased by an average of 0.08 inches (Figure 3.1).

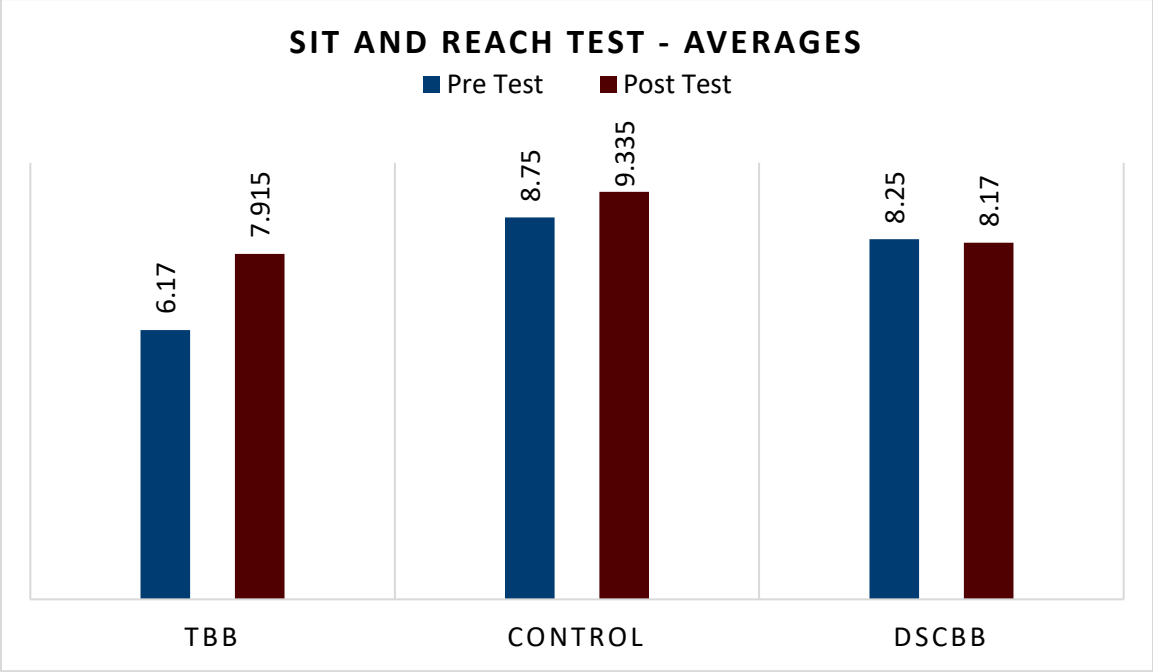

Figure 3.1: The average scores for the Sit and Reach Test for each group before and after intervention.

3.2 Ankle Stability

The plantar flexion repetition test was used to measure the participant's ankle stability before and after intervention. The TBB group increased the average number of relevés they completed on their right foot by 1.5 relevés and decreased the average number of relevés they completed on their left foot by 0.5 relevés. The control group significantly increased the average number of relevés on their right foot by 11 relevés. On their left foot the Control group increased their average number of relevés by 1. The DScBB group increased their average number of relevés by 2 on their right foot and completed the same average number of relevés on the left foot (Figures 3.2 and 3.3).

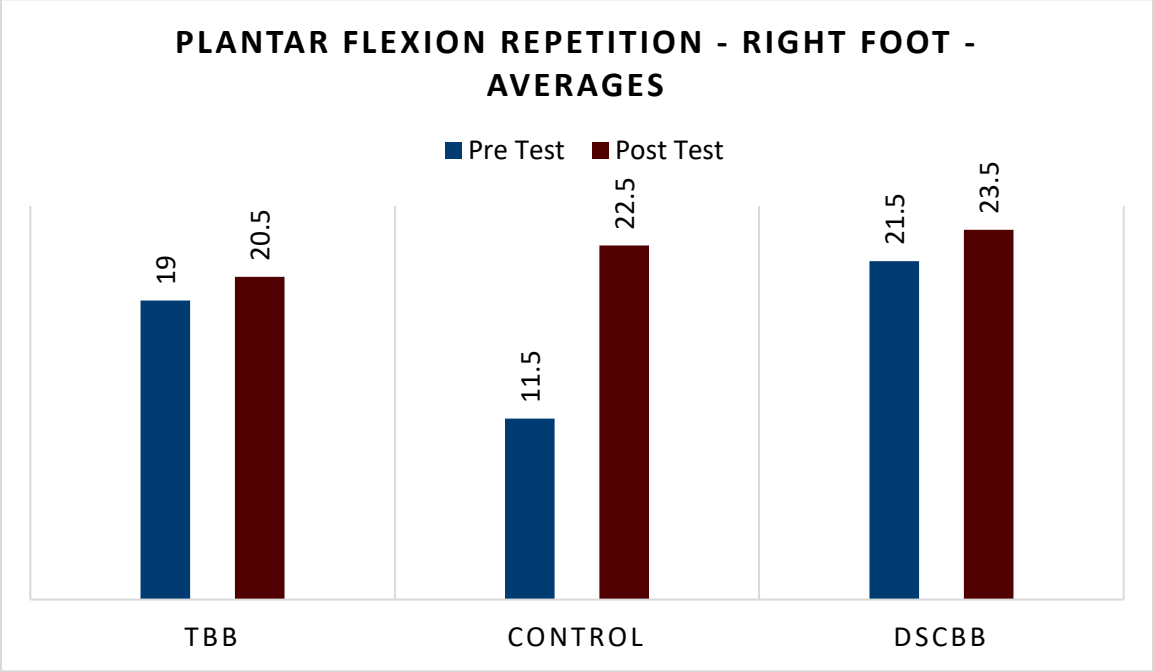

Figure 3.2: The average scores for the Plantar Flexion Repetition Test for the left foot for each group before and after intervention.

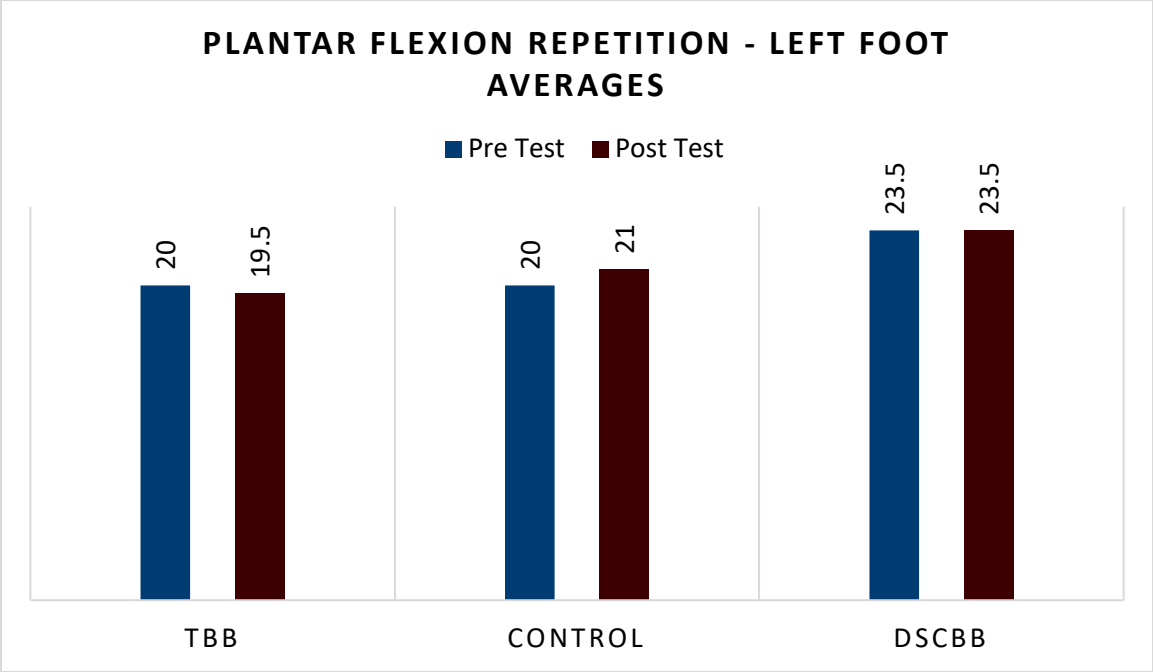

Figure 3.3: The average scores for the Plantar Flexion Repetition Test for the left foot for each group before and after intervention.

3.3 Abdominal Strength and Endurance

The plank hold was used to measure abdominal strength while the FitnessGram Curl tests was used to measure abdominal endurance. The TBB decreased in the plank hold by 20.825 seconds and the Control group also decreased in the plank hold with a decrease of 8.755 seconds. The DScBB group showed improvement in the plank hold with an increase of 2.39 seconds (Figure 3.4).

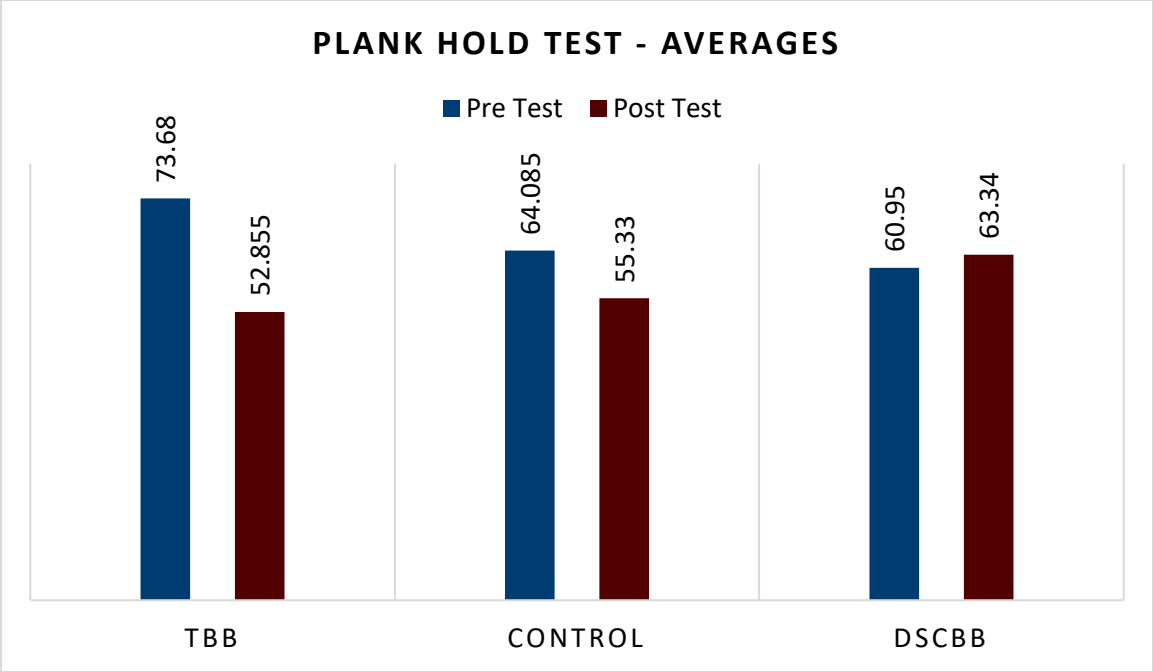

Figure 3.4: The average scores for the Plank Hold Test for each group before and after intervention.

Using the FitnessGram curl test to measure abdominal endurance, the TBB group's average decreased by 7 sit ups. The control group showed the most improvement with an 8 sit up average increase. The DScBB group also showed a minimal increase in abdominal endurance with an increase of 0.5 sit ups (Figure 3.5).

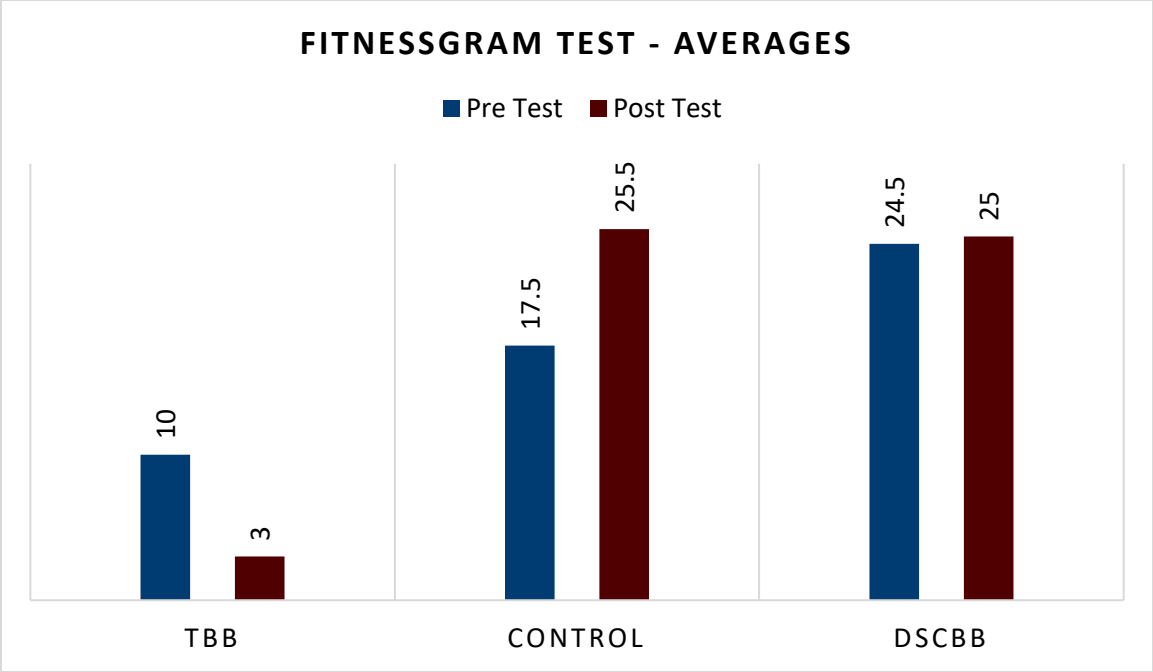

Figure 3.5: The average scores for the Plank Hold Test for each group before and after intervention.

4. DISCUSSION

The analysis of the data collected in this study does not lead to a clear superior structure between the DScBB and the TBB. The TBB increased the most in flexibility, the control group showed the greatest increase in ankle stability and abdominal endurance, and the DScBB showed the only increase in abdominal strength.

4.1 Center Barre and Abdominal Muscles

While the data collected did not show obvious trends favoring either a TBB or a DScBB, there was a trend that with a larger, more in-depth study may reveal a statistical significant difference. By looking at the data presented in Figure 3.4 and Figure 3.5, one can see that the DScBB showed an improvement in both the abdominal strength and abdominal endurance tests, while the TBB decreases in both strength and endurance. The level of data collected from the FitnessGram Curl-Up Test in Figure 3.5 is also significantly different between the DScBB and TBB groups. The average number of curl-ups the TBB group was able to accomplish post-intervention is three, while the DScBB is 25. Previous research has would suggest that this increase in abdominal endurance and strength in the DScBB is due to more muscle activation without the use of a barre (Wilmerding, 2001). Without the use of the apparatus, the participant is required to gain stability from their muscular strength alone. It is likely that the consistent activation of the abdominal muscles that the DScBB group experienced without the ballet barre increased both their abdominal strength and endurance. The disparity that Wilmerding (2001) found between the muscular requirement of the standing leg at the barre compare to in the center could be decreased by the enhanced abdominal stability that comes from training without the barre. The removal of the ballet barre is an added challenge to the demanding technical precision

of classical ballet but could be one that better prepares the dancers for the strength, endurance, and stability they need to perform well.

4.2 COVID-19 and Possible Constraints

There were several limitations that could have contributed to skews in results including limited participants, online feedback, an outliner that was found in the control group, and the frequency of the intervention. Due to this study being done during the COVID-19 pandemic, there were a limited number of participants willing to engage in research studies due to residing locations, fear, and economic situations. Another study done with more participants may be able to see a greater change in the findings. This study was also conducted via Zoom, due to COVID-19, which limited the amount of physical feedback and corrections that the investigators were able to see and give. Feedback in a ballet studio allows the instructor many angles to view the dancer and the opportunity to help participants find proper alignment in their bodies with tactile cues. Zoom and social distancing have limited this feedback to verbal cues based on the one angle of the dancer's body that is being shown on the computer screen. This is a limited version of the true nature of a ballet class and likely impacted the results.

In regards to intervention frequency, most dancers have ballet class that last for 2 hours 2-3 times a week. This study only included a 45-minute barre class once a week. Lastly, the outliner within the control group was due to the teaching schedule of one of the control participants. This participant taught dance class to small children which required them to actively demonstrate flexibility and abdominal strength exercises. They admitted to implementing several dance science elements into their classes such as proper warm-ups, and cool-downs that included static stretching. Future research should be done using the same questions in a setting with fewer limitations and increased study participation.

5. CONCLUSION

The long-term significance of this study lies in the future work that can be done based on the background and methods presented. Exploration into other independent variables that could be changed to represent dance science research, the long-term effects of restructuring the ballet barre, and the results of restructuring an entire ballet class all have yet to be researched. Better access to participants to repeat this study and similar ones could begin to provide ballet teachers with a barre structure that prioritizes the dancer's physical health while preserving the history of classical ballet. This study hopes to inspire others to find ways to implement current dance science research into the classroom setting and put the knowledge gained into practice.

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