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The Effects of Pilates Mat Classes on Abdominal Core Control and Dance Performance: A Pilot Study

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ABSTRACT

In ballet and modern dance classes, dancers are taught to use their core strength to execute movements with efficient alignment and proper technique. Pilates is an exercise regimen used by dancers to improve strength, flexibility, and coordination. However, there is limited scientific research on the impact of Pilates for dancers to support these claims. The purpose of this pilot study was to investigate the effectiveness of a progressive Pilates mat program on core strength and engagement during dance performance. Dancers (n=3) participated in a 10-week study consisting of two weeks of pre and post testing and eight weeks of a progressive Pilates mat intervention program. Pre and post-test comparisons in the plank strength test showed a statistically significant improvement for all three dancers. In a survey administered at the end of the study, the dancers perceived an overall improvement in awareness and engagement of the core during dance class. Inconclusive results were found in the movement phrase indicating that Pilates training may or may not improve dance technique.

Keywords: Pilates, dance, core control, dance performance

INTRODUCTION

Ballet and modern dance techniques are athletic, artistic, expressive and skilled art forms that require years of training to master. For dancers to have long careers and maintain proper health, good technique is required (McMillian, et al., 1998). The physical demands of choreography over the past 20 years have increased the need to train outside of the traditional dance class. Koutedakis and Jamurtas (2004) state “the physical demands placed on dancers from current choreography and performance schedules make their physiology and fitness just as important as skill development.” Dancers, amateur and professional, with a dance only training program find their muscular power, strength, balance and bone and joint integrity problematic (Koutedakis & Jamurtas, 2004). Research has shown physical conditioning improves technical performance in dancers including strength, flexibility, balance and posture (Grossman & Wilmerding, 2000; Angioi, et al., 2009; Kloubec, 2010; Amorium, et al., 2011; Twitchett, et al., 2011). However, the mindset of supplemental physical conditioning impacting the dancer’s aesthetic appearance makes dancers hesitant to incorporate conditioning programs into their training regime (Koutesakis & Jamurtas, 2004; Rafferty, 2010).

Dance and the Pilates Method are known to share similarities including attention to alignment, focus, flow of movement, precision, planes of movement and recognized movement patterns, and therefore may be a compatible training method for dancers (Ahearn, 2006). The Pilates Method has a long history within the dance community beginning with the relationship between Pilates founder, Joseph Hubertus Pilates, and well renowned modern dancer and choreographer, Ted Shawn at the famous Jacob’s Pillow summer workshops¹ during the 1930’s (Latey, 2001). According to Friedman, Eisen and Miller (1980), Joseph Pilates and his training

¹ The Jacob’s Pillow summer workshops continue to the present.

method had the ability to return dancers to the stage after injuries, increasing the relationship between Pilates and dancers such as Hanya Holm, Martha Graham, and George Balanchine. Over the years, many dance companies and schools have incorporated Pilates into their curriculum including universities such as Goucher College, Texas Christian University, and Harid Conservatory (Ahearn, 2006). Even though there is a long history and relationship between dance and the Pilates Method, it has yet to be sufficiently investigated to prove its effectiveness for training dancers (Bernardo, & Nagle, 2006; Bergeron et al., 2017). In order to validate Pilates as a training method for dancers, this study investigated the effectiveness of a progressive Pilates mat program on core strength and control during a dance movement phrase. It also investigated the dancer's perception of Pilates and its impact on core strength, awareness, and its impact on their training.

METHODS

Using a Pre/Post Case Study Intervention Design, improvement in overall core control and core engagement during dance performance was examined. Prior to pre-testing all participants signed an approved IRB (IRB2020-09993D) consent form and filled out an injury questionnaire. Three university dancers (age = 18, height = 163cm \pm 8, mass = 68kg \pm 12) completed the ten-week study. They were free from back, hip, ankle or knee musculoskeletal injuries in the six months prior to the study. For the purposes of this study, an injury was defined as loss of time from dance activities. All participants had been exposed to Pilates Mat work but were not currently training in the Pilates Method. Participants filled out a survey, completed a warm-up, executed a plank test, and were video recorded performing a modern dance phrase in pre and post testing sessions. Participants completed 45-minute sessions twice a week for 8-

weeks, the three participants were led by a Physical Mind certified Pilates instructor through a series of Pilates Mat exercises.

COVID Protocol

This study was conducted during the COVID-19 pandemic therefore protocols were put into place to ensure the safety of researchers and participants. Equipment was cleaned according to CDC guidelines prior to and after each pre/post and intervention sessions Pre and post testing appointment times were staggered and only one participant was in the testing room at a time. All research staff and participants were required to do a temperature check and COVID screening questionnaire prior to each testing and intervention session. Hand sanitizer was used by the researcher and the participant before and after all sessions. Participants and the Pilates instructor wore masks throughout all sessions and mats were placed at a minimum of 6ft apart to maintain social distancing. Increased verbal cues were used with minimal prolonged tactile feedback to ensure the safety of participants and researcher during intervention sessions.

Pre and Post Test Procedures

Once participants were screened for COVID symptoms, participants were asked to perform the plank test on their forearms and to maintain proper placement for as long as possible without a form break. The time, in seconds, was recorded when the participant broke form or stopped on their own. Participants were asked to stop the test if a form break was seen. Form breaks were assessed by a single qualified researcher and included:

- 1) adduction or elevation of the scapulae
- 2) deviation in pelvis alignment such as, anterior tilt of the pelvis, pelvis elevated above or dropping below the height of the shoulder girdle,
- 3) dropping of the head, and/or

4) bending of the knees.

In order to prepare participants for the execution of the movement phrase, they were guided through a warm-up session by a qualified movement specialist (see Table 1).

Table 1: Pre/Post Warm Up Exercises

Exercise	Reps
high knees	20X
side lunge reach (alternating sides)	10X
alternating plié prances in parallel	20X
jumping jacks	15X
walk out to plank	5X
plié pulse to relevé in 2 nd position	8X
plank to side plank alternating sides	4X

After completing the warm-up, participants were video recorded performing a movement phrase.

Movement Phrase

After completing the same warm up used in pre/post testing, participants were asked to perform a movement phrase set to a metronome with 35 bpm (see Table 2). The movement phrase was video recorded and executed on the right and left sides. The movement phrase was repeated and recorded every 2 weeks to determine at what point Pilates training may impact a dancer's movements. Absolute values from a rubric based on 3-point scale ranged from 0-2 with "0" meaning no abdominal control, "1" meaning some abdominal control but not consistent, and

“2” meaning maximum core control throughout. Three dance teachers, who were blind to the order of the movement videos viewed the recorded performance by each dancer and assessed core control during the movement phrase. They were asked to analyze specific movements within the phrase including 1) the circle to the tilt, 2) the tilt position, 3) the handstand. Three evaluators were selected to review and analyze the videos independently. All three evaluators had a background in dance and body sciences with two teaching modern dance to dance majors on a regular basis. The third evaluate had a background in modern dance but does not teach modern dance regularly. Reviewers looked at five criteria to score each participant’s performance. The criteria included: the appearance of muscular engagement in the abdominals, differences in bilateral side bend in the inversion, scapulae engagement in the circle through second and inversion, balance in the tilt, and correct torso placement in the tilt.

Table 2: Movement Phrase for Video Analysis (performed right and left sides). Table description reflections combination on the right side.

Begin in a large 2 nd position (hips externally rotated & abducted)	
Counts	Movement
1-4	Lateral curve left
5-8	Circle through the center in pli� to tilt on the right leg (left leg in tilt)
1-4	Pique to left leg (right leg in pass�)
5-8	Step out right to side lunge
1-4	Tuck and roll to the floor
5-8	Roll to stand and step to second to repeat to the other side

Surveys

Dancers completed a 3-5 item survey as the first step in the pre and post testing sessions. Survey questions consisted of interval scale questions and open-ended questions to collect anecdotal information. Participants were asked to rate their current core strength and control. The scale ranged from 1–5-point with: 1) poor, 2) below average, 3) average, 4) good, 5) excellent. During the pre-test survey, participants were asked the open-ended question, “What do you perceive will happen in the next 8 weeks?” In the post test survey, participants were asked the same Likert scale questions and additional open-ended question, “Do you have any comments you would like to share about the improvements or lack of improvements you have made with this training method?” Participants were also asked if they felt there was a connection between core strength and how well they perform in a dance class. They were also asked to report their current training schedule including the number of dance classes and rehearsals weekly. Participants were also asked to not add any additional conditioning training to their schedule for the length of the study.

Pilates Mat Intervention Program

After initial evaluation, the eight-week progressive Pilates mat intervention began using a yoga mat and medium resistance Theraband. All intervention sessions were conducted in a university dance program Pilates studio. The participants were instructed through each session by the same Pilates instructor. During intervention sessions, a detailed breakdown of the exercises was provided to the participants along with corrective cues for performing the exercises in the appropriate Pilates alignment. Sessions were no larger than two participants at a time to ensure the instructor was able to provide each dancer with precise and well-timed individual cueing and feedback as they performed the exercises. Every two weeks the Pilates program progressed to include new and/or more complex exercises. The Pilates mat program was

divided into a warm-up (5-10 min.), conditioning exercises (30-35 min.), and a cool-down (5 min.). The warm-up did not change throughout the study and included 6 exercises total (see Table 3).

Table 3: Warm Up Exercises

Exercise	Reps
Pelvic Mobility and Stability - Pelvic Clock	5X
Scapulae Engagement - Angel Arms	5X
Articulation Bridging	4X
Pelvic Stability - Marching II (right/left)	4X
Pelvic Stability – Leg Slides	4X
Curl Preps with legs bent in chair position w/Theraband placed across shins	10X

The initial conditioning exercises included during weeks 1-2 of intervention can be found in Table 4. The cool-down exercises did not change throughout the study and included 8 exercises (see Table 5). Every two weeks, as participants become more familiar with the exercises, modifications or additions were made. Adjustments included exercises with increasingly complex positions, additional repetitions, addition of a Theraband, and /or additional exercises. During weeks three and four, changes/additions were made to the exercise regime (see Table 6). Additional changes/additions were made during weeks five and six (see Table 7). In weeks seven and eight, more changes were made to continuing challenging the participants during training sessions (see Table 8).

Table 4: Exercises performed in weeks 1-2 of intervention.

Exercise	Reps
Hundred with knees flexed to 90 degrees w/Theraband across shins	10X
Single Leg Stretch	8X
Coordination, legs open and close three times	8X
Double Leg Stretch	8X
Single Straight Leg Stretch	8X
Side Lying (right and left side) w/Theraband <ul style="list-style-type: none"> • Ab/adduction • Flexion and Extension • Side Kick 	8X each
Prone Heel Beats between right and left side lying work	10X
Swan w/Theraband	5X
Spine Twist (right/left)	5X
Saw (right/left)	5X
Roll down with three biceps curl w/Theraband	5X
Scapulae Support w/Theraband	5X
Opposite Arm/Leg Reach (right/left)	5X
Twist I (right/left)	4X
Leg Pull Front (right/left)	3X

Table 5: Cool Down Exercises

Exercises	Reps
Child's pose	20 sec.
Child's Pose inner thigh stretch (right/left)	30 sec. each side
Downward Dog	30 sec.
Cobra	30 sec.
Lunge (right/left)	30 sec. each side
Lunge with chest expansion (right/left)	30 sec. each side
Pigeon Pose (right/left)	30 sec. each side
Standing hamstring stretch	30 sec.

Table 6: Intervention exercises changes/additions, weeks 3 and 4.

Exercises	Reps
Hundred– straight legs held at 90 degrees with Theraband placed on balls of the feet	10X
Increased Single Leg Stretch	10X
Increased Coordination	10X
New Exercise: Side Lying Leg Work: Small Leg Circles (both directions)	5X
Increased Swan	8X
New Exercise: Roll down oblique w/Theraband right and left sides	5X

New Exercise: Twist II (right/left)	4X
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Table 7: Intervention exercise changes/additions, week 5 and 6.

Exercises	Reps
Hundred on diagonal while maintaining neutral pelvic alignment with Theraband placed on balls of the feet	10X
Coordination legs change to one open/close, and 2 single leg lowers	10X
Increase side lying reps (ab/adduction, flexion/extension and side kick)	10X
New Exercise: Grand Rond de Jambe (en dehors/en dedans)	3X each direction
New Exercise: Swimming	8X
New Exercise: Twist III (right/left)	4X

Table 8: Intervention exercise changes/additions, week 7 and 8.

Exercise	Reps
Hundred – legs on diagonal while maintaining neutral pelvis – single leg lowers	10X
Increase side lying: Small circles reps	8X
Opposite Arm/Leg Reach – Hover position - without Theraband	5X
New Exercise: Leg Pull Back (right/left)	3X

Data Analysis

To analyze the plank test, the duration recorded in seconds pre and post intervention for each dancer was used as well as the difference between these durations, followed by the percentage change. Percentage difference was calculated using the following formula $\% = ((v2 - v1) / v1 \times 100)$ (Campos de Oliveira, et al., 2016). In this formula, v1 was the pre-test value and v2 was the post-test value. For the movement test, the results of the Likert scale were averaged among the 3 reviewers from pre to post test. Closed-ended questions on the pre and post surveys were analyzed comparing values on the 1-5 Likert Scale. For open-ended questions, themes were generated, validated and interpreted with guidance from qualitative researchers.

RESULTS

Plank Test

All three participants showed a significant difference from pre- to post-test for the plank test (Table 9). Participant 1 increased from 81 seconds to 104 seconds; Participant 2 increased from 53 seconds to 124 seconds; and Participant 3 increased from 28 seconds to 56 seconds. Across all three dancers, plank test duration improved an average increase of 41 seconds.

Table 9: Plank Test (Pre and Post Test)

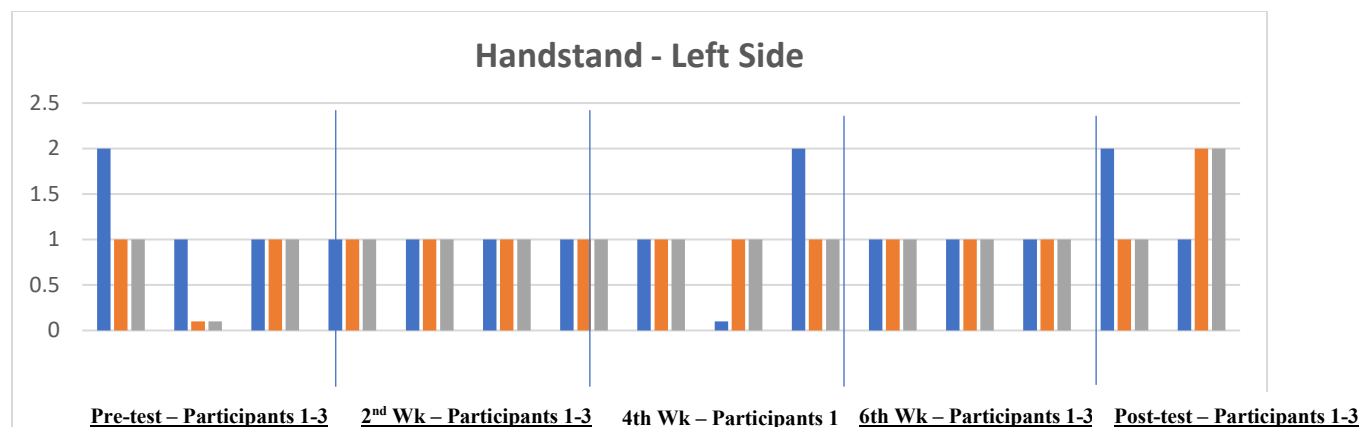
Participant	Pre-Test	Post-Test	Difference (improvement)
Participant 1	81 sec.	104 sec.	23 sec.
Participant 2	53 sec.	124 sec.	71 sec.
Participant 3	28 sec.	56 sec.	28 sec.

Movement Phrase

There were five videos per movement per right/left side for each of the participants, totally 30 videos per dancer and 90 videos for each of the three evaluators to view. Of the 90 videos, there were 32 instances in which all three evaluators did not agree. Fifty-six percent of the time, evaluator two was the outlier in scoring (see Figure 1). There were no instances where all three evaluators disagreed with one another. Additionally, there was no difference between the right and left sides in regard to evaluator discrepancy. The greatest variations were seen on the amount of improvement in a participant, such as a 0 to 1 or 1 to 2 rating. Overall, the instructors agreed there was improvement seen in participants 2 and 3 in all three movements on

both the right and left sides. Participant 2 showed the most improvement among all three participants. The instructors agreed that participant one did decline in the three movements on the right side after the second week, however, began to improve again by post testing.

Figure 1: Handstand Left Side: Sample of Evaluator Ratings for One Skill Assessed



Survey

Results were generated by the responses in the open-ended questions in the pre and post survey including questions on the participant's perception on improved core strength, better core awareness and Pilates impact on dance training. The pre-test survey indicated that two of the participants expected to improve core strength while one anticipated more core awareness. In addition, two predicted Pilates would have a positive impact on their dance training. In post-survey results all participants indicated they perceived improvement on their core strength, two experienced heightened awareness of core control, and one accredited the Pilates training with improving dance training. In the closed-ended question on the pre and post testing survey, participants perceived an overall improvement in their core control.

DISCUSSION

This study used a Pre/Post Case Study Intervention Design to evaluate the effects of a Pilates Mat program on core control in three university dance majors. The results indicated that dancers who experienced a 45-minute Pilates Mat program outside of regular technique classes improved core control as measured with the plank test. Anecdotal evidence indicated the dancer's perceived an improvement in core control and awareness.

According to the anecdotal information provided by the survey, all three dancers stated they perceived more awareness on how to engage and control the core. Participant 3 stated "I have better understanding and awareness on how to hold my core." One dancer mentioned in the open comments that she felt a connection between the Pilates training and dance training, "I am more aware of my abs and keeping them engaged in dance class." Further research should evaluate the discrepancy of perceived improvement between participant and observer.

Limitations

There were some inconsistencies within the results of the dance instructor's evaluation of the participants. The movement phrase was only recorded from a frontal view which may have made it more difficult for the instructors to evaluate the movement. No markers on body landmarks were used and although intentional may have made it more difficult for the evaluators to assess. Viewing a dancer in 2-D may have been challenging and perhaps more difficult than anticipated. Evaluators were asked to look at core control with an emphasis on abdominal engagement however, since some of the movements were difficult to view based on camera angle, instructors may have used varied cues to make a determination. Two study methodologies might have limited the potential to detect improvements: (1) the small range on the Likert scale used to evaluate performance and (2) the simplicity of the movement phrase for some dancers. A

scale with a range (e.g., 0-5), might have allowed the observers to make a finer assessment of each dancer's performance than the 0-2 scale used in the study. In addition, using a more complex movement pattern may provide more opportunity to observe improvements in core control, particularly for the more skillful dancers participating in the study.

The timing of this study during the COVID-19 pandemic, limited the number of participants who were willing to participate. The small number of participants limited the statistical data that could be analyzed. The type of cueing and feedback normally delivered in Pilates training was also limited due to the pandemic restrictions. For example, tactile feedback to correct alignment was contraindicated due to the pandemic. In Gibbons' article on feedback in the dance studio she states, "Hands-on feedback is essential in an art-form that uses the form of the human body." Pilates is also a form of physical activity that uses the vessel of the human body making it important to use kinesthetic or tactile feedback to help correct client's body alignment. Due to the COVID-19 pandemic physical contact was restricted and imagery and verbal cueing were instead used more heavily during training sessions. Based on different learning styles this may or may not have had an effect on post testing outcomes.

CONCLUSION

Increased strength and core control were seen during the standardized plank test for all three participants. Surveys filled out by participants indicated a perceived increase in strength and awareness in core control. The results of this pilot study reconfirms the notion that dancers believe Pilates training is beneficial for dancers. The improvements in the plank test performance for all three dancers suggests that Pilates mat training may improve a capacity that should be important to dancers. However, the absence of a sizeable improvement in dancer

performance of the movement phrase as training proceeded leaves open the question of whether a training program such as the one evaluated in this study can improve dance technique.

Development of more responsive methods for assessing the performance of dance movement is needed. Discussions should continue among dance teachers on what specific visual criteria should be used to indicate effective core control during dance movements. More investigation is needed to determine the relationship between the dancer's individual awareness of core control and the dance teacher's observation of the effectiveness of Pilates training on the dancer's alignment.

Once more responsive measures dance performance are validated, researchers may then profitably undertake an experimental evaluation of the influences of Pilates mat training on dance technique.

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