

PASIG PERFORMING ARTS

SPECIAL INTEREST GROUP



PASIG MONTHLY CITATION BLAST: No.54

October 2010

Dear PASIG members:

The deadline for student applications is fast approaching. Please encourage any students involved in PA research to apply. For more information on the research award please check our webpage (http://www.orthopt.org/sig_pa.php). Students with additional questions can contact Amy Humphrey (ahumphrey@bodydynamicsinc.com).

DEADLINE for application: November 15th.

Our first ***Glossary on Ice Skating*** is included with this Blast. Cheers to Matt Gannott for a sterling job! He has agreed to help with final graphics for our other glossaries. **Volunteers, please send me your completed work!** To get these resources ready for CSM, I'll need them immediately.

Kendra Gage is updating our PA student clinical affiliation list. If you accept students and treat performing artists, please contact her: <kmhgage@gmail.com> She will need to know the following:

- Name of Practice
- Address
- Clinical coordinator
- Phone
- Fax
- E-mail
- % PA treated and type of artist
- Student requirements

Finally, don't forget to start planning your trip to the next Combined Sections Meeting, which will be held in New Orleans, February 9 –12, 2011. PASIG programming and new PA research is always an exciting part of this conference. PASIG programming is Saturday, Feb. 12th, 2011. Please attend our business meeting directly preceding the program!

7:00 – 8:00 PASIG Business Meeting

8:00 – 11:00 PASIG PROGRAMMING: **Movement Impairment Issues in Performing Artists: Considerations for Evaluation and Treatment of Upper and Lower Quarter**

Injuries

8:00 – 8:45 Movement Impairments in the Upper Quarter. Speaker: Lynette Khoo-Summers, PT, Washington University, St. Louis, MO.

8:45 – 9:05 Case Study - Instrumental Musician. Speaker: Jan Dommerholt, PT, Bethesda, MD.

9:05 – 9:25 Case Study - Vocal Musician. Speaker: Alison DeLeo, PT, George Washington University, DC.

9:25 – 10:10 Movement Impairments in the Lower Quarter. Speaker: Lynette Khoo-Summers

10:10 – 10:30 Case Study – Dancer. Julie O'Connell, PT, ATC, AthletiCo, Chicago, IL.

10:30 – 10:50 Case Study – Skater. Jennifer Flug, PT, DPT, OCS, Premier Physical Therapy & Sports Performance, Middletown, DE.

Performing Arts continuing education, courses, and related conferences:

****NEW Performing Arts Independent Study NOW AVAILABLE****

20.3 Physical Therapy for the Performing Artist.

Monographs are available for:

- Figure Skating (J. Flug, J. Schneider, E. Greenberg),
- Artistic Gymnastics (A. Hunter-Giordano, Pongetti-Angeletti, S. Voelker, TJ Manal), and
- Instrumentalist Musicians (J. Dommerholt, B. Collier).

Contact: Orthopaedic Section at: <http://www.orthopt.org>

Also available:

Orthopaedic Section Independent Study Course. *Dance Medicine: Strategies for the Prevention and Care of Injuries to Dancers.*

This is a 6-monograph course and includes many PASIG members as authors.

- Epidemiology of Dance Injuries: Biopsychosocial Considerations in the Management of Dancer Health (MJ Liederbach),
- Nutrition, Hydration, Metabolism, and Thinness (B Glace),
- The Dancer's Hip: Anatomic, Biomechanical, and Rehabilitation Considerations (G. Grossman),
- Common Knee Injuries in Dance (MJ Liederbach),
- Foot and Ankle Injuries in the Dancer: Examination and Treatment Strategies (M. Molnar, R. Bernstein, M. Hartog, L. Henry, M. Rodriguez, J. Smith, A. Zujko),
- Developing Expert Physical Therapy Practice in Dance Medicine – (J. Gamboa, S. Bronner, TJ Manal).

Contact: Orthopaedic Section at: <http://www.orthopt.org>

Combined Sections Meeting

February 9 –12, 2011

New Orleans, LA

PASIG Programming: Movement Impairment Issues in Performing Artists

PASIG Business Meeting: Sat, Feb. 12th

If you know of other courses of interest to our membership, please send the information to: Amy Humphrey PT, DPT, OCS, MTC; ahumphrey@Bodydynamicsinc.com

For this October Citation BLAST, PASIG members Brooke Bishop, Amanda Ting, and Danielle Krynickid have selected the topic *Pilates Training*. The format is an annotated bibliography of articles from 2000 – 2010. The PASIG Research Committee initiated this monthly Citation BLAST on performing arts-related topics in June 2005 in the hopes of encouraging our members to stay current in the literature and, perhaps, consider

conducting research themselves. Each month we send a new list of performing arts (PA) citations to members of the PASIG to further the pursuit of PA-related scholarship. The BLASTS and updated libraries are posted on the PASIG webpage for our members to access and download. (Information about EndNote referencing software can be found at <http://www.endnote.com>, including a 30-day free trial).

As always, your comments, suggestions, and entry contributions to these Citation BLASTs are welcome. Please drop me an e-mail anytime.

Regards,
Shaw

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Pilates Training

The Pilates method, both equipment and mat work, has become an increasingly common tool utilized in orthopedic rehabilitation. In particular, it is often utilized in the cross training and rehabilitation of dancers, gymnasts, and other performing artists. The Pilates method was first developed by Joseph Pilates in late World War I, and was introduced in the United States in 1923. This method consists of over 600 exercises for the various pieces of apparatus utilized, and focuses on conditioning the entire body with an emphasis on balance, control, breathing, posture, and mind-body awareness. Though theoretically this work is easily modified for those with injuries, and has perceived benefits of improving strength, core stability, flexibility, posture, and coordination, the literature supporting the benefits of Pilates in rehabilitation and exercise programs is relatively scarce.

Given the limited, yet growing, body of evidence supporting the benefits of Pilates, the included articles reference several populations outside those in the performing arts. This includes patients with fibromyalgia and low back pain, as well as healthy older adults. The articles below will serve to highlight existing research support for the Pilates benefits many physical therapists have likely already seen within their daily practice. It also demonstrates the need for further high quality, randomized clinical trials exploring the effects of Pilates as a rehabilitative tool.

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Altan L, Korkmaz N, Bingol U, Gunay B (2009). Effect of Pilates Training on People With Fibromyalgia Syndrome: A Pilot Study. Archives Phys Med Rehabil 90: 1983-1988.

Fibromyalgia (FMS) is a chronic musculoskeletal disorder characterized by multiple symptoms including widespread pain, hyperalgesia, fatigue, depression, sleep disturbances, headaches, and urinary frequency. Exercise programs have been shown to be helpful for patients with FMS, though the standardization of the type, intensity, and duration of exercise has not been delineated. This study investigated the effects of Pilates on pain, functional status, and quality of life in people with fibromyalgia. Participants were 50 women with a diagnosis of fibromyalgia, (ages 24-63, mean =49.16 years), who were not taking NSAIDS during the course of the study. The subjects were randomized into 2 groups. Group 1 participated in a 1 hour Pilates training session by a certified instructor 3 times/week, for 12 weeks. Group 2, the control group, was given a home exercise relaxation/stretching program commonly used for patients with fibromyalgia. Outcome measures were pain (VAS) and the Fibromyalgia Impact Questionnaire (FIQ). Significant improvements were observed in pain and FIQ scores in the Pilates group at 12 weeks, and only in FIQ scores at 24 weeks, while no significant improvements were noted in the control group. Significant differences between groups in both scores were found at week 12, but not at week 24. The study concluded that Pilates is a safe and effective method for people with FMS in the short term, and that follow up studies should investigate the long term effects of Pilates on this syndrome.

Bernardo L (2007). The Effectiveness of Pilates Training in Healthy Adults: An Appraisal of the Research Literature. J Bodywork Movement Ther 11: 106-110.

Pilates has gained increasing momentum over recent years as a modality for improving flexibility, strength, and body awareness, though scientific evidence supporting these claims is needed. The purpose of this review was to critically appraise current literature on Pilates in healthy adults. A literature search was performed in which 277 articles were found; 39 articles were published in reviewed professional journals. Three of these articles were clinical trials on healthy adults, and these three articles were reviewed. Overall, weaknesses of these studies included lack of randomization, small sample sizes, and lack of a defined Pilates method. Strengths included the use of established measurements for outcomes and a documented need for research in this area. The results of these studies supported the use of Pilates in healthy adults to improve flexibility, transverse abdominis activation, lumbar-pelvic stability, and muscular activity. Caution should be taken when considering the results of these studies given the lack of sound research methodology used in each study. This review indicated that there is a need for future research using a true experimental design and randomization regarding Pilates and its effect on healthy adults.

Culligan PJ, Scherer J, et al. (2010). A randomized clinical trial comparing pelvic floor muscle training to a Pilates exercise program for improving pelvic muscle strength. Int Urogynecol J Pelvic Floor Dysfunct 21(4): 401-408.

INTRODUCTION AND HYPOTHESIS: The purpose of this study is to determine whether a Pilates exercise program and a pelvic floor muscle-training (PFMT) program could provide similar improvements in pelvic muscle strength. METHODS: Sixty-two women with little or

no pelvic floor dysfunction were randomized to Pilates or PFMT. Each group had 24 biweekly 1-h sessions with either a physical therapist or Pilates instructor. Strength was measured via perineometry (cmH₂O). Two questionnaires--pelvic floor distress inventory (PFDI-20) and pelvic floor impact questionnaire (PFIQ-7)--were also collected. RESULTS: At baseline, the Pilates and PFMT groups measured 14.9 +/- 12.5 and 12.5 +/- 10.4 cmH₂O, respectively (p = 0.41). Both the Pilates and PFMT groups got stronger (6.2 +/- 7.5 cmH₂O, p = 0.0002 and 6.6 +/- 7.4 cmH₂O, p = 0.0002, respectively), with no difference between groups p = 0.85. PFIQ and PFDI scores improved from baseline but not between groups. CONCLUSIONS: Further study is required to determine if Pilates can actually treat pelvic floor dysfunction.

da Fonseca JL, Magini M, de Freitas TH (2009). Laboratory gait analysis in patients with low back pain before and after a Pilates intervention. J Sport Rehabil 18(2):269-82.

With low back pain (LBP) being the most common skeletal muscle problem, it is estimated 80% of adults will experience LBP that will cause temporary leave from work. The etiology of LBP is multifactorial, stemming from factors such as repetitive motion, curvature of the spine, falls and static posture. Pilates training is aimed at training the deep abdominal muscles to decrease stress placed on the spine. Laboratory gait analysis has previously shown alterations in patients with LBP. The aim of the study was to evaluate the influence of pain on vertical ground-reaction force (VGRF) during gait in patients with LBP and the effects of Pilates training on gait in these patients. The study was a single-blind randomized controlled trial with patients divided into two groups, a control group and a low-back group. The low-back group was then sub-divided into a Pilates group and a no-Pilates group. Each participant was evaluated for leg-length discrepancy and all participants in the low-back group were asked to report their history of LBP, pain level on VAS, and present pain intensity. Data was collected on a treadmill using the subjects' preferred and fastest walking speeds. VGRF parameters of first peak force, second peak force, middle-support force, weight acceptance rate, and push-off rate were all measured. The Pilates sub-group attended fifteen sessions of individual Pilates training twice a week. Exercises were progressed from isolated training of the core muscles, co-contraction of the core muscles, co-contraction of the core muscles with limb movements, to co-contraction of core muscles with dynamic functional movements. All groups were similar with respect to baseline age, height, and weight. The Pilates and no-Pilates sub-groups were also similar with respect to age, height, weight, VAS, and pain intensity. Results show significantly lower mean values for weight acceptance rate and push-off rate of the right leg during preferred speed in the Pilates group as compared to the control group. No other parameters showed significant difference between the low-back group and control group prior to Pilates training. Following Pilates training, the treatment sub-group showed significant increases in the middle-support force of the left lower limb during fastest walking speed. With respect to VAS and pain intensity, all showed significant decrease in the Pilates sub-group. Findings indicate that those with referred lower extremity pain use additional strategies to decrease the amount of force placed on the lower extremity. A decrease in pain in the Pilates group is thought to have improved the weight discharge of the left lower extremity during single-leg support stance.

Emery K, De Serres SJ, McMillan A, Cote JN (2010). The effects of a Pilates training program on arm-trunk posture and movement. Clin Biomech 25(2):124-30.

In recent works involving patients with shoulder dysfunction, it has been shown that these dysfunctions may result from result from decreased muscle activity, poor scapular movement with functional tasks, misalignment of the upper spine, and poor thoracic posture. In the Pilates method, development of the pelvic and shoulder girdles is the initial focus by using muscle recruitment strategies. Once control has been established, focus shifts towards segmental alignment and spine stability while moving. The purpose of this study

was to investigate the effects of a Pilates program on trunk and shoulder biomechanics. The authors hypothesized that after 12 weeks of Pilates, participants would show significant improvements in biomechanical characteristics of spine and shoulder posture, motion and arm-trunk muscle patterns. Participants were divided into two groups, a Pilates training group and a non-training control group. All participants performed a biomechanical assessment protocol before and after the 12-week period. The group receiving Pilates training attended two one-hour private sessions per week over 12 weeks. The sessions included mat exercises, exercises with the Reformer and trapeze table. Exercises were progressed to include supine arm exercises to develop control of the shoulder girdle, spine motions and use of equipment to test postural stability. Arm-trunk kinematics were recorded using Simulator technology while performing a shoulder flexion task under various conditions with participants using their dominant arm. Maximum voluntary effort (MVE) was calculated for isometric shoulder flexion and passive range of motion (PROM) was also measured. Lower abdominal strength was assessed by having subjects lay supine and slowly lower the lower extremities toward the floor. Upper trunk kinematics were also recorded using a six-camera motion analysis system. Muscle recruitment patterns were measured using EMG of 16 muscles of the arm and scapula. Results showed a significant 3-way interaction effect for peak shoulder flexion reached during the shoulder flexion task, reduction in scapular posterior and mediolateral linear displacements during shoulder flexion, and upper thoracic extension range of motion during the shoulder flexion task decreased significantly after Pilates training. Core strength also improved in the Pilates group. These results suggest better dissociation between the upper limb and scapula during shoulder flexion, improved scapular stability, and increased ability to stabilize the upper thoracic region. It was also found that the amount of thoracic kyphosis was significantly decreased after Pilates training. Subjects did not show improvement in shoulder PROM or shoulder flexion MVE. A 12-week Pilates training program was effective in improving core strength, posture, and some aspects of scapular and upper trunk mechanics. Future studies should focus on clarifying the effects of Pilates on the scapula and the effects on those with neck and shoulder dysfunction.

Endleman I, Critchley DJ (2008). Transversus Abdominis and Obliquus Internus Activity During Pilates Exercises: Measurement With Ultrasound Scanning. Arch Phys Med Rehabil 89: 2205-2212.

All classic Pilates exercises involve the classic imprint action, pulling the navel toward the spine, with the aim to activate the transversus abdominis and obliquus internus. These are muscles indicated to have a role in spinal stability. The aim of this study was to assess the activity of the transversus abdominis (TrA) and obliquus internus (IO) muscles during classic Pilates exercises performed correctly and incorrectly, and with or without equipment. Participants were a volunteer sample of 18 women and 8 men without back pain who had been training in Pilates for at least 6 months. Muscle thickness measurements were taken via ultrasound imaging during the Pilates imprint, the hundred, roll-up, and single leg circle, performed both correctly (abdominals drawing inward) and incorrectly (allowing the abdominals to push outward). Results indicated that TrA and IO thickness increased during the mat imprint, hundreds on the mat and on the reformer, leg circle, and roll-ups compared with resting. TrA thickness was greater with reformer versus mat hundreds. During incorrect imprint, neither TrA nor IO thickness differed from resting. This study provides initial confirmation that Pilates exercises do activate the TrA and IO as claimed. Use of the reformer may activate the TrA more during certain exercises.

Gladwell V, Head S, Haggart M, Beneke R (2006). Does a Program of Pilates Improve Chronic Non-Specific Low Back Pain? J Sports Rehabil 15: 338-350.

Back pain has been associated with dysfunction of the transversus abdominis, multifidus, pelvic floor muscles, and diaphragm. Pilates aims to specifically train the above core

muscles submaximally to increase tone and strength, and lengthen and stretch the lumbar spine to decrease compression of the joints. The aim of this study was to evaluate the effect of a program of modified Pilates for active individuals with chronic non-specific low back pain. Participants were 49 individuals with chronic low back pain (pain > 12 weeks, ages 18-60) who were randomized into a Pilates group and control group. The Pilates group underwent 1-hour-long Pilates classes 1 time per week over the course of six weeks. They also performed the exercises taught in class at home for two 30 minute sessions per week without supervision. The control group received no treatment other than analgesics and participation in their normal activities. Improvements were seen in the Pilates group post-intervention in general health, sports functioning, flexibility, proprioception, and decreased pain. These improvements were not seen in the control group. This study indicates that a program of modified Pilates can help decrease pain, improve overall general health, and increase proprioception and flexibility in those with chronic non-specific low back pain.

Herrington L, Davis R (2005). The influence of Pilates training on the ability to contract the transverses abdominis muscle in asymptomatic individuals. J Bodywork Movement Ther 9:52-7.

The purpose of this study was to assess and compare transverse abdominal muscle contraction in a Pilates trained, abdominal curl trained and a control group using a PBU (pressure biofeedback unit) during a transverse isolation test in the prone position and unilateral heel lift test. The author's background in Pilates training was not specified. The Pilates trained group attended one or two 45 minutes Pilates classes per week for 6 weeks. The transverse isolation test included subjects to lie prone with a pressure sensor under the abdomen and the PBU was inflated to 70mmHg. The second test completed was the lumbo-pelvic stability test, this required unilateral heel-lift in the sagittal plane and was performed with flexion of the hip from the starting position 70 degrees to the barrier 90 degrees, then returning to 70 degrees with the knees flexed. Results of this study indicated that the percentage of individuals in the Pilates group was higher in pass rates for both the Transverse isolation formal test and the lumbo-pelvic stability test. The results of this study indicate a significant difference between the Pilates trained, abdominal trained and control groups. The limitations of this study included limited information about the trained Pilates group and limited information about the trained abdominals group.

Hutchinson MR, Tremain L, et al. (1998). Improving leaping ability in elite rhythmic gymnasts. Med Sci Sports Exerc 30(10): 1543-1547.

PURPOSE: The purpose of this study was to improve the leaping ability of athletes in rhythmic gymnastics, a high leap demanding sport, using a controlled course of jump training. **METHODS:** Six elite athletes underwent a course of leap training including pool training and Pilates' Method of Body Conditioning using spring controlled resistance to muscular exertion. Baseline data was obtained on a force plate that measured reaction time, leap height, and explosive power on each athlete before initiating training. **RESULTS:** After 1 month of training, leap height improved 16.2%, ground reaction time improved 50%, and explosive power improved 220%. With continued maintenance training, no decrease in effect was noted; however, no significant improvement occurred after the first month of training. At 1 yr with discontinuation of the leaping protocol but continued training within the sport, the initial gains were likewise maintained. No injuries occurred during participation in the leaping protocol. **CONCLUSIONS:** Elite rhythmic gymnasts can safely improve their leaping ability significantly through an intense course of jump training. Continued training with the leaping protocol does not appear to further enhance the benefit; however, the gains appear to be maintained at 4 months and 1 yr post training with or without additional training with the leaping protocol.

Jago R, Jonker ML, Missaghian M, Baranowski T (2006). Effect of 4 weeks of Pilates on the body composition of young girls. Preventive Med 42(3):177-80.

In previous studies, it has been shown that regular exercise reduces the risk of adolescent obesity. Physical activity has been found to be particularly low in girls and more options for participation are needed. To date, there have been no studies to address the possible use of Pilates in the adolescent population and if Pilates would provide enough aerobic demand to produce a reduction in fasting insulin levels. The aim of this study was to determine the effect of Pilates on body composition, waist circumference, and blood pressure of young girls as well as to assess their satisfaction with Pilates as a form of exercise. Thirty participants (average age=11.2) were recruited from two YMCA after-school programs. One program was randomly assigned to serve as the intervention site with 16 participants attending a one-hour Pilates class each day for four weeks. The control group continued to proceed with their usual activities during the four-week period. Height, body weight, body mass index, waist circumference, and blood pressure were all recorded pre- and post-intervention for all participants. During each Pilates class, four randomly selected participants wore heart rate monitors and completed perceived exertion ratings at the end of the session. At baseline, there were no significant differences between the two groups. Results show a significant time by group interaction for BMI percentile with a 3.1 reduction in BMI for the Pilates group using repeated measures ANOVA. Mean heart rate of the Pilates group was found to be 104bpm, mean perceived exertion was 5.9 and mean attendance was 75%. With moderate perceived exertion ratings and the resulting heart rate data, Pilates was not an aerobic activity and the authors suggested it may be combined with other preferred exercises to enhance changes in BMI. Limitations to the study include a small sample size, limited age range of the subjects, and short intervention period. The study results suggest that Pilates may be an effective form of exercise for adolescent girls to reduce the risk of obesity and increase overall activity level.

Kloubec JA (2010). Pilates for improvement of muscle endurance, flexibility, balance, and posture. J Strength Condition Res 24(3):661-7.

It is important to address accessibility and enjoyment when creating exercise programs, especially for those who have been physically inactive. Originally called “contrology,” Pilates encourages movement during the early stages of rehabilitation by providing assistance as needed. Pilates is typically performed as a series of 25-50 repetitive low-impact exercises aimed at flexibility and muscular endurance of the abdominals, low back, hips, thighs, and buttocks. Even though it is marketed to all populations including those with low back pain and rheumatoid arthritis, little research has been conducted to test its efficacy and validity. The purpose of this study was to evaluate the change in abdominal endurance, hamstring flexibility, upper-body endurance, posture, and balance after Pilates exercise. The authors hypothesized that all variables would improve after 12 weeks of Pilates training. Fifty subjects were recruited to participate and were randomized into two groups of 25, one group receiving Pilates training (average age=42.08) and one control group (average age=45.84). Subjects were evaluated pre- and post-intervention with respect to height, weight, One-minute YMCA sit-up test, leg lowering ability, maximum number of push-ups (ACSM protocol), sit and reach Test, and supine hamstring flexion test. Posture was also assessed using a clear postural analysis grid, as well as balance using a balance board recording the number of deviations. Subjects attended one-hour Pilates classes based on the Stott Pilates method, twice a week for 12 weeks consisting of 25 essential exercises using a Pilates mat. Using 1-way ANCOVA, all variables showed a significant increase after Pilates intervention, except for balance. The authors hypothesized that balance may not have been improved due to the lack of sensitivity in the measure used. In the future, studies should focus on the transfer of proper body form required by Pilates to other forms of exercises and daily activities as well as the use of Pilates for specific populations.

Kuo Y, Tully EA, Galea MP (2009). Sagittal Plane Spinal Posture After Pilates-Based Exercise in Healthy Older Adults. Spine 34; 1046-1051

Theoretically, maintaining ideal posture produces minimal stress on joint structures and uses minimum energy. Ageing is associated with postural changes such as increased thoracic kyphosis, forward head, and decreased lumbar lordosis, all of which can possibly lead to adverse health conditions. Pilates based exercise claims to improve posture, through few articles have been published to support such claims. The purpose of this pretest-posttest study was to determine changes in sagittal plane spinal posture in older adults during standing and sitting after a Pilates-based exercise program. Participants were 34 healthy adult volunteers (10 men, 24 women, age>60). The subjects underwent Pilates training with individualized exercises chosen from a program developed by certified instructors. Each attended a 75-minute session, including mat and equipment work, 2x/week, for 10 weeks at participating studios. The program included strengthening, stretching, balance, core stabilization, and thoracic extension exercises as well as postural education. They did not perform exercises at home. Posture was analyzed using a two-dimensional PEAK Motus motion analysis system. Results indicated that participants stood with slightly more thoracic extension immediately after the exercise program, but the change declined 4 weeks after the program terminated. They also sat with slightly increased lumbar extension immediately after the exercise interventions. No significant differences were found in the 4 week follow up testing. The short duration of the exercise program, lack of home practice, and relatively erect posture of the participants initially may have contributed to the lack of significant changes in posture in this study. Further investigation is needed to determine the long term effects of Pilates on posture in ageing adults.

La Touche R, Escalante K, Linares MT (2008). Treating Non-specific Chronic Low Back Pain Through the Pilates Method. J Bodywork Movement Ther 12: 364-70.

Chronic low back pain is a contributor to high medical expenses and lost work time for adults, and many patients with low back pain never fully recover. Studies have indicated that certain types of rehabilitative exercise may be beneficial in treating non-specific low back pain. The aim of this study was to review scientific articles in which the Pilates method was utilized as treatment for non-specific low back pain. Inclusion criteria for articles included 1) randomized controlled trials and clinical controlled trials, 2) carried out on adults with low back pain, 3) treatment utilized was the Pilates method, and 4) studies were published in English. Two RCT's and one clinical controlled trial were selected for retrospective analysis performed by two independent reviewers. The PEDro and Jadad scales were used for evaluation of methodological quality. The studies analyzed indicated positive effects of using the Pilates method in the rehabilitation of low back pain; positive effects included improved function and reduction in pain. An important aspect of the reviewed studies was that prescribed Pilates exercises were based on parameters specific to rehabilitative purposes, and therefore were distinguished from the classic Pilates method. Limitations of the studies include small sample sizes, lack of control group in one of the studies, and that a moderate number of subjects were lost to follow-up. This study concluded that further research, using larger sample sizes, is required to determine the specific parameters to be applied when using the Pilates method to treat non-specific chronic low back pain.

Lugo-Larcheveque N, Pescatello LS, et al. (2006). Management of lower extremity malalignment during running with neuromuscular retraining of the proximal stabilizers. Curr Sports Med Rep 5(3): 137-140.

This case report presents a high-level female runner with a history of more than 25 years of recurrent lower extremity (LE) injuries and LE malalignment problems during running. Due to her LE malalignment, she has been unable to run for the past 3 years. A definitive diagnosis was not found for her inability to run so by exclusion we diagnosed dysfunction of the hip, spine, and pelvic stabilizers that resulted in her in LE malalignment. To treat this muscle weakness, we designed a Pilates-evolved functional movement intervention to improve the control and strength of the proximal stabilizers and regain normal LE alignment. The Pilates-

evolved treatment approach involved a series of functional and progressive resistance exercises designed to dynamically stabilize the spine, pelvis, and hip through all planes of motion. After 1 year of Pilates-evolved training, the athlete's disabling movement pattern resolved and she has returned to a regular running program. The purpose of this case report is to describe a Pilates-evolved functional movement intervention that resolved this runner's LE malalignment and returned her to running when other traditional treatment approaches were not effective in doing so.

Petrofsky J, Morris A, Bonacci J, et al. (2005). Muscle use during exercise: A comparison of conventional weight equipment to Pilates with and without resistive exercise device. J Applied Res 5 (1): 160-73.

The purpose of this study was to examine the effects of a resistive band on muscle compared to Pilates without a resistive band and to commercial exercise equipment. The authors background in Pilates was not specified, however this study was completed at Loma Linda University and Azusa Pacific University. EMG was used to determine the muscle activity for each exercise, which for the commercial weight lifting and Pilates included, back extensors and flexors, leg abduction-adduction, abdominal, quadriceps and hamstrings. This study used resistance equipment for Pilates, which included an oblong ring with a resistance band. According to the results the researchers found that muscle activity during Pilates with the bands was equivalent to the medium weight level on commercial exercise equipment. The limitations of this study include a small sample size, the tension of resistive bands is not equivalent to weight lifted on commercial weight equipment, unspecified medium weight level and the authors of this study did not have a focused literature review. The literature review included additional topics such as obesity, diet, diabetes and rehabilitation.

Queiroz B, Cagliari M, Amorim CF, Sacco IC (2010). Muscle Activation During Four Pilates Core Stability Exercises in Quadriped Position. Arch Phys Med Rehabil 91: 86-92.

Dynamic control of core musculature plays an important role in preventing repetitive injury of the lumbar spine via their contribution to lumbar-pelvic stabilization. Exercises to target these muscles can be performed in several positions. In the early stage of rehabilitation, one of the most commonly recommended positions in literature is the four-point kneeling position, as it helps to reduce spinal loads and train optimal recruitment patterns of specific trunk muscles. In the Pilates method, exercises known as knee stretch are performed on the Reformer in the quadruped position, though little literature has investigated muscle activation for these particular exercises. The purpose of this study was to compare the activity of stabilizing and trunk and hip muscles in 4 variations of Pilates Reformer exercises in the quadruped position. Subjects were 19 healthy Pilates instructors and ballet dancers (12 women, 7 men) with significant Pilates experience. They performed 4 variations of the knee stretch exercises (retroverted pelvis with flexed trunk, anteverted pelvis with extended trunk, neutral pelvis with inclined trunk, neutral pelvis with trunk parallel to the ground) while surface EMG signals were recorded for the iliocostalis, multifidus, gluteus maximus, rectus abdominis, and external and internal oblique muscles). 12 repetitions of each variation were performed. Results showed that the retroverted pelvis with trunk flexed position increased external oblique and gluteus maximus muscle activation, and decreased multifidus activity. The anteverted pelvis with trunk extension increased multifidus muscle activity and also challenged the internal oblique. The neutral pelvis position significantly decreased activity of all muscles. Rectus abdominis activation was relatively low level in all positions, though showed some higher activity in the retroverted pelvis with trunk-flexed position. Results of the study suggest that changes in trunk and pelvic positioning alters muscle recruitment during the knee stretch exercises, and that the rectus abdominis likely stabilizes the pelvis during the exercises and controls extensor torque generated by hip extension on the Reformer's sliding platform.

Rydeard R, Leger A, Smith D (2006). Pilates-Based Therapeutic Exercise: Effect on Subjects with Nonspecific Chronic Low Back Pain and Functional Disability: A Randomized Controlled Trial. J Orthop Sports Phys Ther 36: 472-483.

General conditioning programs to train strength and endurance of the spine musculature have been shown to reduce pain intensity and disability in patients with chronic nonspecific low back pain. Low back pain of this nature has been associated with problems with neuromuscular control of trunk muscle stability and movement efficiency, and some research indicates that specific training of the deep abdominals and paraspinals has been effective in reducing pain in populations with diagnoses such as spondylolisthesis. Proper function of the gluteal muscles is also noted to be important in lumbar-pelvic stabilization; patients with low back pain demonstrate dysfunction of the gluteus maximus relative to other muscles. The aim of this study was to investigate the efficacy of a specific exercise intervention based on the Pilates method in a population with chronic nonspecific low back pain. 39 physically active subjects between 20 and 50 years old with chronic low back pain (>6 weeks). The control group received "usual care," while the intervention group underwent training on a specialized Pilates exercise regimen (using the mat and Reformer) for 3 one hour sessions per week, and a 15 minute home program 6 days per week, for 4 weeks. The program focused on specific activation of the deep abdominals, pelvic floor, multifidus, and gluteus maximus. Results indicated that there was a significantly lower level of functional disability and average pain intensity in the specific-exercise group than in the control group post intervention. Improved disability scores were maintained in the exercise group up to 12 months following this intervention. Treatment with a modified Pilates approach was concluded to be more effective than usual care in a population with chronic nonspecific low back pain.

Segal NA, Hein J, Basford JR (2004). The effects of Pilates training on flexibility and body composition: an observational study. ArchPhys Med Rehabil 85(12):1977-81.

Due to current interest and in an effort to compliment current therapies, patients commonly seek wellness programs. Over recent years, many have begun practicing Pilates as an adjunct to treatment, which was previously only utilized by dancers and athletes. Stott Pilates is an altered Pilates program in which preparatory exercises are the main focus with the aim to maintain a neutral spine and improve safety with exercise. The purpose of the study was to determine if Pilates training increased flexibility, increased truncal lean body mass, improved posture, improved health self-assessment, and to provide evidence of any side effects. Subjects were adults over the age of 18 who joined a Pilates class at a health club during a six-month period. A one-hour Pilates class was attended each week by the subjects. The first two months consisted of a standard Stott Pilates mat program and exercises were progressed in difficulty over the second and third two-month training periods. Participants were assessed with respect to composite flexibility, body composition, perception of health and function at baseline, two, four and six months during treatment. An event log was also kept to record any problems with the Pilates classes. Initially, forty-seven subjects were interviewed for participation, however, 36 returned for two-month follow-up, and 37 and 32 for 4 and 6-month follow-up. After statistical analysis, composite flexibility improved significantly from baseline at median (IQR) of 0.2cm as measured by fingertip-to-floor distance. At two, four, and six-months, median improvement values were 3.4cm, 3.3cm, and 4.3cm, respectively. All other variables did not show statistically significant improvement, and subjects self-assessment of health status also did not change. The authors hypothesized that the absence of body composition change was due to the isometric nature of the Pilates exercises and that the participants only attended one class per week. The study was limited by the absence of a proper control group, small sample size, and subjects lost to follow-up. Future studies involving a control group and more frequent participation should be conducted.

Sekendiz B, Altun O, Korkusuz F, Akin S (2007). Effects of Pilates exercise on trunk strength, endurance and flexibility in sedentary adult females. J Bodywork Movement Ther 11: 318-326.

Pilates exercises have been shown to be effective for improving balance among a group of dancers, and have also been shown to be beneficial for patients with low back pain.

However, studies on the effects of Pilates on sedentary individuals are limited. The aim of this study was to examine the effects of Pilates mat exercises on abdominal and lower back strength, abdominal muscular endurance, and posterior trunk flexibility in sedentary adult females. Body mass index and body fat ratios were assessed as secondary outcomes. Subjects were 45 sedentary academican volunteers in a university who did not perform regular exercise. They were randomized into a Pilates and a control group. Participants in the Pilates group performed supervised Pilates Mat exercises for 60-minute sessions, 3 times per week, for 5 weeks. The control group's conditions were not described in the study. Results of pre and post-testing revealed significant improvements in abdominal muscular endurance (measured as maximum number of curl-ups performed in 1 minute) and posterior trunk flexibility (measured by the sit and reach test) in the Pilates group vs. the control group post-intervention. There were also significant improvements in abdominal and lower back extensor strength (measured as torque produced on a Biodex system) in the Pilates group as compared to controls. No differences were noted in BMI or body fat for either group. The authors concluded that this study demonstrated positive effects of Pilates mat exercises on abdominal and lower back muscle strength, abdominal endurance, and posterior trunk flexibility in sedentary adult females. A longer intervention and diet modification may be required to produce changes in body fat.

Smith K, Smith E (2005). Integrating Pilates-based core strengthening into older adult fitness programs. Topics Ger Rehabil 21 (1): 57-67.

The purpose of this study is to explore the theoretical framework of integrating Pilates-based core strengthening into resistance and balance training directed at improving older adult's quality of life and the key considerations relative to the evidence base and the training of health professionals. The author's background in Pilates included certification through Stott Pilates. The authors focused on the clinical perspective and how Pilates is composed of several different muscle synergies such as isometric, eccentric, and concentric muscle contractions and co-contractions. This study also identifies that neuromuscular control of the torso can be influenced by training balance. The authors also discuss how integrating core strengthening is a more important form of exercise to improve functional movement, proprioception and coordination. The authors discuss that older adults may lack the confidence to use free weights and machines or may not have access to them, therefore Pilates exercise may be more appropriate for them.