ABSTRACT

COMPARING PILATES TO GENERAL EXERCISE IN ADULT PATIENTS WITH CHRONIC LOW BACK PAIN: A META-ANALYSIS ON GLOBAL PERCEPTION, PAIN, AND QUALITY OF LIFE

**Background**: Low back pain (LBP) has been a significant health care concern for decades, and prevalence continues to rise. There is evidence that exercise is used to gain strength and decrease instability in chronic patients; however, little evidence exists on which method is the most effective and efficient. General supervised exercise includes strengthening and stretching of main muscle groups, but is typically not tailored to meet each patient’s separate needs. Pilates is one method of core stabilization that has standardized movements that can be individually modified. The hypothesis is that Pilates has a greater treatment effect when compared to general exercise in improving pain, Global Perceived Effect, and the mental components of quality of life in patients with chronic low back pain. **Results**: Six articles were included. Pilates was superior to general exercise in decreasing pain (ES = -0.49, 95% CI = -0.63 to -0.34) and improving Global Perceived Effect (ES = 0.88 , 95% CI = 0.60 to 1.16). The mental components of the SF-36 gave inconclusive results whether Pilates is superior (ES = 0.00, 95% CI = -0.30 to 0.29). **Conclusion**: Pilates is superior to general exercise at decreasing pain while improving Global Perceived Effect.

Julie Elaine Simonian
May 2016
COMPARING PILATES TO GENERAL EXERCISE IN ADULT PATIENTS WITH CHRONIC LOW BACK PAIN: A META-ANALYSIS ON GLOBAL PERCEPTION, PAIN, AND QUALITY OF LIFE

by

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submitted in partial fulfillment of the requirements for the degree of Doctor of Physical Therapy
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APPROVED

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST OF TABLES</td>
<td>vii</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>viii</td>
</tr>
<tr>
<td>BACKGROUND</td>
<td>1</td>
</tr>
<tr>
<td>Low Back Pain</td>
<td>1</td>
</tr>
<tr>
<td>Mental Elements in CLBP</td>
<td>2</td>
</tr>
<tr>
<td>Interventions for Low Back Pain</td>
<td>2</td>
</tr>
<tr>
<td>General Exercise</td>
<td>3</td>
</tr>
<tr>
<td>Core Stabilization Exercise</td>
<td>4</td>
</tr>
<tr>
<td>The Pilates Method</td>
<td>4</td>
</tr>
<tr>
<td>Pilates in Rehabilitation</td>
<td>6</td>
</tr>
<tr>
<td>METHODS</td>
<td>8</td>
</tr>
<tr>
<td>Search Criteria</td>
<td>8</td>
</tr>
<tr>
<td>Inclusion and Exclusion Criteria</td>
<td>8</td>
</tr>
<tr>
<td>Outcome Measures</td>
<td>9</td>
</tr>
<tr>
<td>Quality Appraisal and Assessment of Methodologic Quality</td>
<td>10</td>
</tr>
<tr>
<td>Statistical Analysis</td>
<td>11</td>
</tr>
<tr>
<td>RESULTS</td>
<td>12</td>
</tr>
<tr>
<td>Study Selection</td>
<td>12</td>
</tr>
<tr>
<td>Study Characteristics</td>
<td>12</td>
</tr>
<tr>
<td>Risks of Bias Within Studies</td>
<td>12</td>
</tr>
<tr>
<td>Synthesis of Results</td>
<td>13</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>15</td>
</tr>
<tr>
<td>Summary of Evidence</td>
<td>15</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 1. General Exercise Programs and/or Activities ......................................... 30
Table 2. SF-36 Items and Dimensions ................................................................... 31
Table 3. Patient Characteristics ............................................................................. 32
Table 4. Study Characteristics .............................................................................. 33
Table 5. Details of Critical Appraisals ................................................................. 35
Table 6. PEDro Scale ........................................................................................... 36
Table 7. Confidence Intervals and Effect Sizes ....................................................... 37
Table 8. Psychometric Data for the FABQ in the CLBP Population ....................... 38
<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1</td>
<td>Pilates’s bed spring use</td>
<td>40</td>
</tr>
<tr>
<td>Figure 2</td>
<td>Pain rating scales</td>
<td>40</td>
</tr>
<tr>
<td>Figure 3</td>
<td>Selection process</td>
<td>41</td>
</tr>
<tr>
<td>Figure 4</td>
<td>Difference in pain scores from pre- to postintervention</td>
<td>42</td>
</tr>
<tr>
<td>Figure 5</td>
<td>Global perceived effect</td>
<td>42</td>
</tr>
<tr>
<td>Figure 6</td>
<td>SF-36 mental components</td>
<td>43</td>
</tr>
<tr>
<td>Figure 7</td>
<td>The roll up</td>
<td>43</td>
</tr>
</tbody>
</table>
BACKGROUND

Low Back Pain

Low back pain (LBP) has been a significant health care concern for decades, and prevalence continues to rise.\(^1,2\) Low back pain complaints usually begin around 18 years of age and peak at 60, with more severe forms of back pain developing as age increases.\(^3-6\) This condition has a lifetime prevalence of up to 80%, affecting both males and females with approximately 25% of the population seeking care for low back pain within a six-month period following onset.\(^1,3,5\) One in 10 patients who are diagnosed with LBP have symptoms that never resolve, and 3 out of 5 will have recurring pain.\(^1\) Low back pain patients account for over $24 billion spent annually, which equals 3.22% of the total health expenditure, in the United States.\(^1\) This does not include non-financial costs to the patient and family members that are no longer able to partake in social activities, affecting many aspects of their quality of life and increasing disability.\(^7\)

Based on both clinical and research descriptions, defining LBP can be challenging. Some definitions of LBP include the area located between the lower rib cage and gluteal folds or the area between the inferior-most aspect of the scapula and lower extremities.\(^8-12\) Other definitions simply state LBP and leave the exact boundaries unspecified.\(^13-15\)

Although area specifications vary, the clinical course of LBP can be consistently categorized as acute, subacute, or chronic with episodes lasting less than 1 month duration, between 2 and 3 months, and greater than 3 months, respectively.\(^1,4,9,13,16,17\) Most episodes of acute LBP resolve spontaneously, while only 1 in 3 resolves completely.\(^4\) Approximately 60% of this population has recurring symptoms and develop chronic pain and disability, which consume the
bulk of LBP compensable resources.¹ Not only is this group costly, chronic LBP (CLBP) reports have also risen within the last decade.¹⁻⁴,⁹,¹³,¹⁶,¹⁷ Common attributes to an escalation in CLBP are an increase in obesity, changes in psychosocial and physical work demands, higher depression prevalence, increased symptom awareness and reporting, fear of pain and reinjury, an aging population in the workforce, and low expectations for recovery.²⁻⁴ Due to the prevalence and associated costs, interventions should be emphasized that prevent the transition of pain to a chronic state or decrease time spent in that phase.⁴

**Mental Elements in CLBP**

Before investigating interventions, practitioners need to assess both the physical and mental components of CLBP: pain intensity, disability, and quality of life.¹⁸ Each of these aspects can be heavily affected by emotional distress, dysfunctional pain coping, and avoidance behaviors.¹⁸,¹⁹ This mental component of pain and disability is generally ignored when assessing CLBP and any acute exacerbation of a chronic condition.¹⁸ In order to deliver an appropriate intervention breaking the cycle of chronic pain, the mental aspects cannot be ignored.²⁰

**Interventions for Low Back Pain**

The American Physical Therapy Association’s Clinical Practice Guidelines for low back pain recommend 8 types of interventions based on peer-reviewed literature for treatment that should be considered.⁴ In-depth definitions of these interventions are included in Appendix A. Some of these interventions have specific recommendations for particular groups, while others are general. Centralization and directional preference exercises and procedures as well as flexion exercises, traction, and nerve mobilization procedures should be primarily
used for patients with spinal stenosis, nerve root involvement, and/or radicular symptoms. Manual therapy and patient education and counseling should be employed with all patients with LBP, regardless of diagnosis or stage. Trunk coordination, strengthening, and endurance exercises should also be utilized for all LBP patients; however, application of this intervention is particularly suggested for chronic pain patients. Progressive endurance and fitness activities should be used as a strategy for chronic pain patients as well. Although there has been evidence that these exercises are used to gain strength and decrease instability in chronic patients, little evidence exists on which method is the most effective and efficient.4

General Exercise

General supervised exercise includes strengthening and stretching of main muscle groups as well as cardiovascular activities to reverse deconditioning caused by a sedentary lifestyle.13,16,21-27 This type of exercise is typically not tailored to meet each patient’s separate needs with respect to impairments or diagnoses; however, it is customized based on their physical abilities (i.e., customizing sets, repetitions, resistance, and progressions of each).

There is an inconsistency in regards to exactly which exercises to perform, which area of the body to target, how many sets and repetitions to perform, as well as when and how to progress the activity.13,21,27-29 Methods vary from activation of trunk extensors and flexors only, to the addition of leg extensors, to utilization of the upper body and extremities.13,27,28 Studies also simply use one form of aerobic exercise or a mixture of all of the above.21,29 For a sample of general exercises used in randomized trials, refer to Table 1. All of the studies in the sample utilized monoplanar movements; none attempted activities in multiple planes.13,21,27-29
Some progressed activities by only increasing repetitions while others changed the effect of gravity or increased resistance.\textsuperscript{13,21,27-29}

**Core Stabilization Exercise**

In core stabilization exercises, concentration is on the muscles that stabilize the spine and pelvis. This primarily includes the transversus abdominis, multifidi, internal oblique, deep paraspinals, pelvic floor muscles, and gluteals.\textsuperscript{30} When this group of muscles work together efficiently, ground-impact forces are dispersed equally, minimizing compressive, translation, or shearing forces on single areas of the body.\textsuperscript{31} Since movement coordination impairments caused by trunk musculature dysfunction (i.e., muscle atrophy, severe fat infiltration, etc.) are associated with back pain, proper core activation should be considered for the basis of treatment to improve trunk control/stabilization.\textsuperscript{4,32-34} In the literature, this is described as motor control exercise, transversus abdominis training, lumbar multifidus training, and dynamic lumbar stabilization; however, like general exercise, inconsistencies exist with exact exercises and activities to be performed as well as the method of administration.\textsuperscript{4} One method that encompasses all of these concepts with the feature of standardized movements and individually modified is the Pilates Method.\textsuperscript{35,36}

**The Pilates Method**

Joseph Pilates introduced his basic exercise ideals in the early 1900s during World War I, when he was 32 years old.\textsuperscript{35,37} During the war, he was held at an internment camp where he encouraged all internees and guards to partake in his conditioning regime, which was performed on the ground.\textsuperscript{35,38} This type of exercise later formed his mat work.\textsuperscript{38} Towards the end of World War I, he used the same exercises on soldiers in the hospital recovering from their injuries.\textsuperscript{35,38}
As most of these patients were bed bound, Pilates utilized bed springs for assistance or resistance to movement, which is shown in Figure 1. He found patients recovered tone more quickly and soon adapted his apparatus use.\textsuperscript{35,38}

In 1926, Pilates moved to the United States, opened his first studio, and coined his method Contrology.\textsuperscript{35,36,38} It wasn’t long before he developed a relationship in the dance community in New York, rehabilitating dancers primarily after low back or lower extremity injuries.\textsuperscript{38,39} Since Pilates’s studio opening, exact technique has evolved with different methods, but the fundamental principles have remained unchanged. This encompasses 6 principles: concentration, control, centering, flowing movement, precision, and breathing.\textsuperscript{35,36} Many words and phrases in particular categories are associated with the Pilates Method; however certain associations have become integral in proper performance.\textsuperscript{36} These include core stability, flexibility, muscle control, mind-body connection, posture, and strength.\textsuperscript{21,36,40}

The first published mat Pilates regime consisted of 34 basic exercises with very specific instructions regarding how the exercises should be performed: where each body part should be and when, when to inhale and exhale, cautions, and remarks.\textsuperscript{41} Activities evolved into more complicated actions beginning with simple movements and advancing into more difficult, multi-planar whole-body exercises.\textsuperscript{42}

Today, the use of the Pilates Method is growing exponentially. A Google Scholar search in January 2016 using only the term Pilates yielded approximately 1,350 results when filtering the time frame from 1900 to 2000. That number jumps to 9,260 when searching years 2001 to 2010 and increases to 12,500 results when searching years 2011 to 2015. Its use and integration has grown not only
with dancers, but athletes and the general public for fitness as well as an emerging post-acute rehabilitation method.\textsuperscript{35,36}

**Pilates in Rehabilitation**

The essential aspects of the Pilates Method target the specific muscular dysfunctions that occur with movement coordination impairments.\textsuperscript{43} It is this aspect that will lead to decreased pain and disability while improving quality of life in patients with CLBP.\textsuperscript{43} Exercises are performed in supine, prone, side-lying, quadruped, sitting, or standing with or without equipment.\textsuperscript{38} This variety allows the patient to perform any faulty movement pattern successfully and correctly, limiting unwanted muscle activity.\textsuperscript{44} An activity can be broken down into individual components to target specific impairments with the required assistance for unflawed and safe completion.\textsuperscript{44} Once these components are achieved proficiently, the patient can be advanced towards a desired task to efficient functional movement with specific progressions per activity.\textsuperscript{44}

Systematic reviews and meta-analyses have been performed to assess the efficacy of Pilates in the treatment of CLBP; however conflicting evidence exists. Most studies concluded Pilates was superior when compared to a minimal exercise or minimal intervention program (consisting mainly of education) in reducing pain and disability.\textsuperscript{11,45,46} However, some argue Pilates did not improve functionality when compared to simply resuming daily activities, with no additional exercise intervention.\textsuperscript{12}

When comparing Pilates to other exercise interventions, there is conflicting evidence with wide diversity when attempting to reach a conclusion on which is superior in treating patients with CLBP.\textsuperscript{10,12,15,45-47} Numerous limitations in the articles assessed within these studies exist, consisting of risk of bias, small sample
size, heterogeneity of pooled studies, scarcity of trials including Pilates, and low methodological quality of studies. Process limitations within systematic reviews and meta-analyses include flaws in their review procedure and limitations in quality assessment.

Due to these inconsistent conclusions, the growing popularity of Pilates in the rehabilitation setting, and new readings in the literature, further assessments need to be performed. The previous studies discussed have also used pain and function as their primary outcome measure; however they devalue the importance of the mental components of the rehabilitation process. The purpose of this meta-analysis is to utilize new trials performed, compare Pilates to general exercise programs implemented for CLBP, and assess the mental and emotional portion of rehabilitation with pain.
METHODS

Search Criteria

All searches were performed using Google Scholar and the California State University, Fresno Henry Madden Library master search, which primarily consisted of CINAHL, EBSCO, PubMed, ScienceDirect, and Cochrane Library. For a full list of databases included in the Henry Madden Library database, refer to Appendix B. The following search terms were used: Pilates, low back pain, chronic low back pain, nonspecific low back pain, chronic nonspecific low back pain, exercise, general exercise, randomized controlled trial, control trial, controlled trial, core strengthening, core strength, core stabilization, lumbar stabilization, pelvic stabilization, low back pain, improving pain, quality of life, and improving function. Each article was assessed by 2 independent reviewers for future analysis and entered into EndNoteX7 for organization and the identification of duplicates.

Inclusion and Exclusion Criteria

Only randomized controlled trials (RCTs) were included for this meta-analysis. Other inclusion criteria consisted of being written in English, published in a peer-reviewed journal from 2005 to present, used subjects at least 18 years of age, utilized at least one pain outcome measure and/or one quality of life measure with mean and standard deviation reported for each, and examined both males and females.

Studies that compared Pilates with electrical stimulation and/or another type of specific exercise intervention that would not fall into the trunk coordination, strengthening, and endurance exercise categories (e.g., Yoga, Qigong, McKenzie, etc.) were excluded. Other exclusion criteria consisted of
studies on subjects with low back pain from specific physician-diagnosed medical conditions (e.g., scoliosis, multiple sclerosis, ankylosing spondylitis), trauma, or after surgery.

**Outcome Measures**

The outcome measurements used in the meta-analysis include the Short Form-36 Health Survey (SF-36), Global Perceived Effect scale (GPE), and an 11-point Pain Scale.

**SF-36**

The SF-36 uses a Likert method for patients to rate their limitations within 8 health concept subscales in the past 4 weeks.\(^{48}\) Their function is rated on a 1 to 3 scale for each question, representing activities which are limited a lot, a little, and not at all, respectively.\(^{48}\) The overall score is out of 100, where greater health status is represented as a higher score.\(^{48}\) This meta-analysis analyzes 4 of the 8 domains, which include the mental components of the survey: role limitations because of emotional health problems, vitality (energy/fatigue), social functioning, and general mental health (psychological distress and psychological well-being).\(^{48}\) The other 4 domains cover the physical components, including physical functioning, role limitations due to physical problems, bodily pain, and general health perceptions.\(^{48}\) For a complete list of summary measures, scales, and items refer to Table 2. Although the SF-36 is utilized for a wide variety of health conditions, psychometric properties have extensively been assessed for Parkinsonism, with a lack of exact values for low back pain patients.\(^{49-51}\)
Global Perceived Effect

Global Perceived Effect assesses patient-rated recovery weighed on a numerical scale ranging from -5 to 5. The patient is asked to quantify how much their condition has improved or declined since a previously defined point in time, with -5 representing a decline and 5 representing an improvement. The GPE has been recommended for use as an outcome measure in numerous chronic pain trials, including LBP. It has excellent test-retest reliability and reproducibility (intraclass correlation coefficient values of 0.90 for CLBP); however as time between tests increases, so does the influence of a patient’s current status rather than scoring the difference in overall recovery.

Pain Rating

To quantify pain, an 11-point scale was used where 0 represents no pain and 10 equates to most pain. Two different scales were assessed and are shown in Figure 2: Visual Analog Scale (VAS) and Numeric Pain Scale (NPS). For VAS, the patient is asked to mark their pain level on a horizontal line measuring exactly 10 cm, while the NPS uses whole numbers from 0 to 10. The VAS and NPS are highly correlated in patients with chronic pain conditions, and are appropriate for comparison.

Quality Appraisal and Assessment of Methodologic Quality

Each article included was analyzed using the Physiotherapy Evidence Database Rating Scale (PEDro). This assessed the quality and significance of each randomized controlled trial. Within this scale, there are 11 items; however, the first item is not used in the final scoring, and relates to the study’s external validity. For complete explanations of each criterion, refer to Appendix C.
Critical appraisals were utilized to further screen each article for the assessment of risk of bias.56

**Statistical Analysis**

Each study’s means, standard deviations, and number of participants were entered into Microsoft Excel with statistical calculations performed to compute pooled standard deviations, effect sizes, and upper and lower confidence intervals. If a study did not have pretest and posttest scores reported with both means and standard deviations without adjustments, correspondence with the author(s) was attempted. Studies were paired for analysis only if pretest means and standard deviations were similar, assigning Pilates exercise into the experiment group and general exercise to the control.

A fixed effect model was used for within study variance and a random effect model was utilized to assess between study variance. These calculations were used to formulate forest plots to compare the grand effect size (ES) of included studies. Confidence interval (CI) was set at 95% with a p-value of 0.05 to identify statistical significance. Heterogeneity was calculated using Q-statistic. Cohen’s ES index was used to classify small, medium, and large effects as 0.30, 0.50, and 0.80 respectively.57

This study was performed utilizing the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist for accuracy and reliability.58
RESULTS

Study Selection
Extensive search of the databases noted above yielded 842 articles. Out of those, 327 were not peer-reviewed, 153 were duplicates, and 354 did not match the PICO or did not meet the inclusion and exclusion criteria. Of the remaining 8 articles, 2 were excluded as there was no statistical comparison available for the outcome measures used. This selection process is outlined in Figure 3.

Study Characteristics
All 6 trials included patients 18 years of age with a maximum age ranging from 50 to 80. Mean age of all groups utilized within this analysis was 46. Total number of subjects from all groups was 426, including 285 females and 141 males. Mean duration of symptoms ranged from 3 to 12 months up to 13.6 years. Five of the 6 trials held sessions for 60 minutes, while the other held sessions for 50 minutes. Duration of treatment ranged from 2 times per week for 6 weeks, 12 weeks, and 90 days to a total of 12 sessions over 8 weeks. For full descriptions of patient and study characteristics, refer to Tables 3 and 4, respectively.

Risks of Bias Within Studies
A systematic evaluation was performed using the University of Oxford’s Centre for Evidence-based Medicine Critical Appraisal tool.\textsuperscript{56} This assessment analyzes randomization, allocation, and the objectivity of the outcome measures used. Details of these appraisals are included in Table 5. Five questions are asked regarding internal validity and 3 for external validity. All 6 articles used had randomized assignments, dropouts accounted for, and used objective measures. Wajswelner et al\textsuperscript{13} was the only trial with both experiment and control groups
assessed; therefore, the groups’ similarities at baseline and participants being treated equally were not applicable for the remaining studies. For external validity, all trials could be generalized and had feasible treatment, with benefits outweighing harms.

To further assess validity and quality, the PEDro scale was used. Five articles scored 8 out of 10, while one scored 7 out of 10. Due to the differences in exercise activities, blinding of participants and therapists was not achieved. In one study, blinding of assessors did not occur. For an itemized list, refer to Table 6.

**Synthesis of Results**

Due to the scarcity of literature comparing Pilates to general exercise, experimental and control groups from each study were combined. An experimental group (groups receiving Pilates) was paired with an appropriate control group (groups receiving general exercise) based on similarities within baseline means and standard deviations per outcome. Comparison data consist of upper and lower confidence intervals as well as effect sizes which were calculated via equations entered into Microsoft Office Excel, with respective forest plots generated.

First, evaluating pain, the difference in pain scores from baseline to post-intervention was utilized to minimize discrepancies across studies with higher or lower pretest pain reports. A Q-statistic of 7.23 with 6 degrees of freedom and associated p-value of 0.30 shows homogeneity among studies. A grand total ES of -0.49 with upper CI of -0.34 and lower CI of -0.63 shows the Pilates group had a moderate treatment effect compared to the general exercise group. The negative ES is desired due to the aspiration of pain reducing during treatment. All
confidence intervals and effect sizes are shown in Table 7 with the forest plot illustrating difference in pre- and post-intervention pain scores in Figure 4.

Global Perceived Effect was calculated by cross-analyzing 3 studies. Two studies represented the experiment group and one as the control. One Pilates trial was further broken down into mat and equipment groups, making 3 groups for the experiment. Homogeneity among studies was proven with a p-value of 0.80 and Q-statistic equal to 0.45 with 2 degrees of freedom. A grand total ES of 0.93 with upper CI of 1.16 and lower CI of 0.70 shows the Pilates group had a large treatment effect compared to the general exercise group. Figure 5 illustrates the respective forest plot.

The SF-36 Mental Components were calculated utilizing 3 studies as well; however only 2 studies were combined. One study represented the Pilates group, one as general exercise, and the third represented both groups within itself. Homogeneity was achieved with a p-value of 0.21 and Q-statistic equal to 1.57 with one degree of freedom. A grand total ES of 0.00 with upper CI of 0.29 and lower CI of -0.30 shows no cumulative treatment effect when comparing the Pilates group to the general exercise group. Figure 6 shows the forest plot comparing these studies.
DISCUSSION

The purpose of this meta-analysis was to utilize new trials performed, compare Pilates to general exercise programs implemented for CLBP, and assess the mental and emotional portion of rehabilitation with pain.

Summary of Evidence

This analysis supports Pilates in decreasing pain and improving patients’ Global Perceived Effect when compared to general exercise. However, due to limited studies utilizing the mental components of the SF-36, results are inconclusive whether Pilates has a greater effect.

Objective Measures

Pain

While pain is often used as an objective measurement via its numerical rating, it is very much a subjective response. If the emotional portion of pain is not addressed, pain will likely not improve substantially. At the very center of every Pilates principle is the integration of body and mind. The incorporation of mind into exercise and movement is one feature general exercise alone lacks.

Not only are Pilates’s principles grown out of the body and mind root, the structure of each exercise is also based off of this collaboration. Each exercise has a standard movement that has regressions or progressions depending on the individual’s abilities and performance, falling into an established basic, intermediate, or advanced level. Since springs can first assist the entire motion in Pilates, a patient can perform an exercise pain free. This gives them the ability to move safely and properly, gaining confidence that movement will not cause pain. The same principles are applied with mat exercises. If the movement
causes pain, it is either modified to a more basic form or not performed. The acknowledgement that movement will not cause pain can be the first step in breaking the chronic pain cycle.\textsuperscript{20} Once this is achieved, they can be progressed with multiple modifications appropriate for that particular patient, with the root exercise remaining the same.\textsuperscript{59} General exercises also have some modifications, but they are very limited in the adjustments available without changing the entire activity.

For example, the purpose of a roll up (as seen in Figure 7) is to gain abdominal strength, stretch posterior musculature, and achieve spinal articulation.\textsuperscript{42,60} If a patient cannot accomplish this activity due to weakness and/or painful muscle guarding, they can be placed on a trapeze table to assist the movement for precision and comfort via springs.\textsuperscript{42} These springs can be adjusted based on how much assistance is needed, and then readjusted or removed as the patient gains control, further reducing their fear of movement and eventually achieving a whole-body pain free motion.\textsuperscript{42} If said equipment is not available, a patient can begin with an assisted roll up: in supine with knees bent, hands behind knees, ending in sitting position then returning to supine.\textsuperscript{42}

In contrast, a curl-up aimed at improving strength of abdominal musculature, did not have a significant standard modification available.\textsuperscript{27} Bronfort et al\textsuperscript{27} adjusted load simply by arm placement (at side, on chest, behind neck, and overhead).

**Global Perceived Effect**

When assessing GPE, the same principles as pain come into play. The general exercise study utilized in this analysis attempted to incorporate the mind component more than the other general exercise trials. Ferreira et al\textsuperscript{21} used
cognitive-behavioral management in hopes of altering the relationship between pain and movement, ultimately attempting to improve the GPE. This model has been shown to improve a patient’s pain experience and coping in respect to back pain.\textsuperscript{61} While Ferreira et al’s\textsuperscript{21} GPE scores did improve by 3.8 points when comparing pre- to post-intervention, the Pilates groups improved by 4.2 to 4.7 points.\textsuperscript{9,17}

Further comparison of the Pilates groups to Ferreira et al\textsuperscript{21} showed possible explanations for the drastic improvement in the GPE. Both da Luz et al\textsuperscript{17} and Miyamoto et al\textsuperscript{9} performed their Pilates interventions on an individual basis, while Ferreira et al\textsuperscript{21} carried out their interventions in groups of no more than 8 patients. Refer to Table 4 for intervention administration across all trials. Perhaps the simple one-on-one feedback and possible encouragement from the administrators in the Pilates groups, gave those participants an improved perception that the group atmosphere didn’t provide.

Short Form-36

Although the SF-36 has been extensively used to assess quality of life in all low back pain patients, it may not be the most appropriate tool for this population, most specifically to evaluate mental components. There is a lack of established reliability and validity measurements as well as exact statistical values to represent true change within the CLBP population. The mental components of the SF-36 also do not address the fear of movement that usually heavily impacts chronic pain intensity and coping.\textsuperscript{62,63}

Perhaps another quality of life measure that does assess these missing factors would be more appropriate for this population. The Fear Avoidance Belief Questionnaire (FABQ) was developed specifically for investigation of these
beliefs in LBP patients in the clinical setting with a physical activity subscale (PA) and a work subscale (W). This survey consists of 16 items asking the patient to report how different activities affect their pain on a 0 to 6 scale, with 0 representing disagreement of pain related to activity and 6 demonstrating agreement. The FABQ has excellent test-retest reliability, an interrater/intrarater reliability ICC (intraclass correlation coefficient) of 0.94, with adequate predictive pain value validity, and established normative data for the CLBP population. Refer to Table 8 for psychometric data.

**Pilates and Physical Therapy**

The results from this study should not be construed as a suggestion to replace traditional physical therapy and rehabilitation with Pilates. Rather, Pilates can be viewed as an approach to exercise and a strategy of healing with rehabilitative benefits that can be administered alongside conservative methods (manual therapies, modalities, etc.).

Plainly, rehabilitation specialists, as medical professionals, will address all aspects of pathologies and impairments while understanding contraindications for those pathologies. In contrast, Pilates instructors are assessing overall alignment, movement coordination impairments, and control. These differences need to be realized when assessing what would be best for the patient. In an interview with the president and co-founder of Polestar Pilates, he made the following statement: “If [Pilates] is not working or there is clearly a structural issue, the client needs to move into physical therapy. After physical therapy, Pilates can provide cost effective post-rehab benefits.”

Due to the quickly growing popularity and use of Pilates, the Pilates Method Alliance (PMA) was formed to connect the Pilates community, establish
standards, and promote professionalism.\textsuperscript{71} The PMA maintains certification and continuing education standards internationally.\textsuperscript{71} This agency not only sets the stage for safety in Pilates, but further emphasizes safety in Pilates with rehabilitation.

There are 10 highly respected, comprehensive instructor programs that are available both in the United States and internationally.\textsuperscript{72} Each of these programs have taken a slightly different approach, either strictly adhering to the original practices of Joseph Pilates or combining the old ideals to new techniques and developments in exercise science.\textsuperscript{72} Some concentrate on body mechanics and proprioception, while others emphasize the rhythm and flow of movements; however, the balance of body and mind remains unchanged and quintessential.

Polestar Pilates is a current leader in this integration with a strong rehabilitative component to their educational training.\textsuperscript{72} Polestar was founded by Brent Anderson, who has a PhD in physical therapy and was part of the item writing committee for the PMA Pilates Certification Exam.\textsuperscript{73,74} This relationship sets the stage for standardized, safe collaboration of Pilates and physical therapy.

The decision to integrate Pilates into a physical therapy practice requires a cost analysis. To become trained by a reputable school and earn certification with the PMA, training can cost between $4,000 and $5,000 or more.\textsuperscript{72,75} If this cost is too high for a practice, one can start by experiencing Pilates themselves and integrate principles into clinical practice. An individual can also find a certified Pilates instructor in the area and build an effective communication line to refer patients once discharged from formal therapy.\textsuperscript{69}

Another cost that needs to be taken into consideration is equipment. If there is limited space available or funds are not available for a full studio, combo tables are obtainable that mixes a Reformer and a Trapeze Table and can also be
utilized as a plinth.\textsuperscript{75} The price for these can range from $3,500 to $5,000.\textsuperscript{75} If a full integration of Pilates into practice is desired, a full studio can cost upwards of $25,000 to $40,000 or more.\textsuperscript{75}

**Future Research**

Additional research should be performed to fully assess the mental effect of Pilates over a general exercise regime, utilizing potential studies that were excluded in this analysis and possibly a different mental outcome measure.

**Conclusions**

From the results of this meta-analysis, Pilates is superior to general exercise at decreasing pain while improving Global Perceived Effect for individuals with chronic, nonspecific LBP. This meta-analysis illustrates how Pilates can be utilized to break the cycle of fear of movement in the CLBP population. With its increasing popularity, standards should remain upheld by educational tools and regulations. Through these standards, practitioners can utilize this method to continue patient rehabilitation and bridge Pilates with physical therapy.
REFERENCES


67. George SZ, Fritz JM, McNeil DW. Fear-avoidance Beliefs as Measured by the Fear-Avoidance Beliefs Questionnaire: Change in Fear-Avoidance Beliefs Questionnaire is Predictive of Change in Self-report of Disability and Pain Intensity for Patients with Acute Low Back Pain. *Clinical J of Pain.* 2006;22(2):197-203.


TABLES
<table>
<thead>
<tr>
<th>Author</th>
<th>Exercises/Definition Utilized</th>
</tr>
</thead>
</table>
| Bronfort et al    | Aerobic warm-up, static stretches focusing lumbar, gluteal, and hamstring musculature  
Prone trunk extensions, prone leg extensions, supine anterior abdominal exercises (curl ups), bird dog                                                      |
| Brooks et al      | Indoor stationary cycle training                                                                                                                                                                                            |
| Ferreira et al    | Cardiovascular warm-up, stretching of main muscle groups  
Diagonal trunk curl, sideways steps, star jumps, press-ups, leg raise sideways, leg raise backwards, trunk curls, stand ups, arm circling, bridging                                                                 |
<p>| Shamsi et al      | Exercises activating extensor and flexor muscle groups in a lying position                                                                                                                                                  |
| Wajswelner et al  | Exercise bike, lower limb stretches (calf, quadriceps, adductors, gluteals), triceps dips, biceps curls, standing T-band pulls, bird dog, lumbar twists, bridges, lumbar flexion, cobra, ball crunches, trunk twists and side-bends, ball squats |</p>
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<th>Scale</th>
<th>Item #</th>
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<td></td>
<td>3</td>
<td>Vigorous activities</td>
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<tr>
<td></td>
<td></td>
<td>4</td>
<td>Moderate activities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>Lift, carry groceries</td>
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<td></td>
<td></td>
<td>6</td>
<td>Climb several flights</td>
</tr>
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<td></td>
<td></td>
<td>7</td>
<td>Climb one flight</td>
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<td>Bend, kneel</td>
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<td>Bathe, dress</td>
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<td>Cut down time</td>
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<td>Pain-magnitude</td>
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<td>Pain-interfere</td>
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<td></td>
<td>36</td>
<td>Sick easier</td>
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<td></td>
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<td>34</td>
<td>As healthy as anyone</td>
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<td></td>
<td>33</td>
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<td>18</td>
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<td>Pep/life</td>
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<td>26</td>
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<td>28</td>
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<td>30</td>
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Table 3. Patient Characteristics

<table>
<thead>
<tr>
<th>Author</th>
<th>Group Assessed</th>
<th>Sample Size</th>
<th>Mean Age</th>
<th>Gender</th>
<th>BMI (kg/m²)</th>
<th>Mean Pain Duration</th>
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</thead>
<tbody>
<tr>
<td>da Luz et al\textsuperscript{17} (2014)</td>
<td>Pilates (Mat and Equipment Groups)</td>
<td>Mat: n = 43</td>
<td>43.5 ± 8.6</td>
<td>Mat:</td>
<td>27.0 ± 4.6</td>
<td>Mat: 48 mos</td>
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<td></td>
<td></td>
<td>Equip: n = 43</td>
<td>38.8 ± 9.9</td>
<td>Equip:</td>
<td>26.9 ± 4.2</td>
<td>Equip: 36 mos</td>
</tr>
<tr>
<td>Miyamoto et al\textsuperscript{9} (2013)</td>
<td>Pilates</td>
<td>n = 43</td>
<td>40.7 ± 11.8</td>
<td>34</td>
<td>24.6 ± 4.0</td>
<td>4.7 years</td>
</tr>
<tr>
<td>Natour et al\textsuperscript{8} (2015)</td>
<td>Pilates</td>
<td>n = 30</td>
<td>47.8 ± 11.5</td>
<td>24</td>
<td>23.1 ± 4.9</td>
<td>&gt; 12 mos</td>
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<tr>
<td>Wajswelner et al\textsuperscript{13} (2012)</td>
<td>Pilates and General Exercise</td>
<td>Pilates: n = 44</td>
<td>49.3 ± 14.1</td>
<td>Pilates:</td>
<td>26.5 ± 4.1</td>
<td>13.6 years</td>
</tr>
<tr>
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<td></td>
<td>Gen Ex: n = 43</td>
<td>48.9 ± 16.4</td>
<td>Gen Ex:</td>
<td>26.4 ± 3.9</td>
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<td>Bronfort et al\textsuperscript{27} (2011)</td>
<td>General Exercise</td>
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<td>44.5 ± 11.8</td>
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<td>Not reported</td>
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<td>&gt;36 mo: 52</td>
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* median values given
<table>
<thead>
<tr>
<th>Author</th>
<th>Frequency/Duration</th>
<th>Outcome Measures</th>
<th>Intervention Administration</th>
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</thead>
<tbody>
<tr>
<td>da Luz et al(^{17}) (2014)</td>
<td>60 min sessions 2x/week for 6 weeks</td>
<td>Pain NRS, RMDQ, PSFS, GPE, TSK</td>
<td>15-20 exercises individually supervised by a Pilates-certified physical therapist with 4 years of experience Difficulty modified on basic, intermediate, and advanced levels Maximum 10 repetitions 1(^{st}) session: instructions on the method</td>
</tr>
<tr>
<td>Miyamoto et al(^{9}) (2013)</td>
<td>60 min sessions 2x/week for 6 weeks</td>
<td>Pain NRS, RMDQ, PSFS, GPE, TSK</td>
<td>13 exercises individually supervised by Pilates-certified physical therapist with 3 years of clinical experience Difficulty progressed in basic, intermediate, and advanced levels 5-10 repetitions Educational booklet*</td>
</tr>
<tr>
<td>Natour et al(^{18}) (2015)</td>
<td>50 min sessions 2x/week for 90 days</td>
<td>Sit-and-reach test, Pain VAS, RMDQ, SF-36, NSAID use, satisfaction with treatment</td>
<td>9-11 exercises in groups of 3-4 patients supervised by a certified, physical educator with 10 years of experience in the method</td>
</tr>
<tr>
<td>Wajswelner et al(^{13}) (2012)</td>
<td>60 min sessions 2x/week for 6 weeks</td>
<td>Quebec scale, Pain NRS, PSFS, pain self-efficacy scale, SF-36</td>
<td>12-14 exercises in groups of up to 4 supervised by a physiotherapist with 5-30 years of clinical experience 1(^{st}) session: individual session to prescribe program</td>
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<tr>
<td>Author</td>
<td>Frequency/Duration</td>
<td>Outcome Measures</td>
<td>Intervention Administration</td>
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<td>-----------------</td>
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<tr>
<td>Bronfort et al (2011)</td>
<td>60 min sessions 2x/week for 12 weeks</td>
<td>Pain NRS, RMDQ, SF-36, OTC med use</td>
<td>One-on-one exercise provided by 15 exercise therapists under supervision of study clinicians</td>
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<tr>
<td>Ferreira et al (2007)</td>
<td>60 min sessions 12 total for 8 weeks</td>
<td>Pain VAS, PSFS, GPE, RMDQ</td>
<td>7 stretches, 10 exercises, warm-down, relaxation session, and educational message in groups of no more than 8 patients supervised by a physical therapist 1st session: assessment and teaching of exercises</td>
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</table>

NRS, Numeric Rating Scale; RMDQ, Roland-Morris Disability Questionnaire; SF-36, Short Form-36; OTC, over-the-counter; PSFS, Patient Specific Functional Scale; GPE, Global Perceived Effect; TSK, Tampa Scale for Kinesiophobia; VAS, Visual Analog Scale; NSAID, non-steroidal anti-inflammatory drugs

*booklet included information about the anatomy of the spine, pelvis, and low back and recommendations regarding posture and movements involved in activities of daily living*
Table 5. Details of Critical Appraisals

<table>
<thead>
<tr>
<th>Author</th>
<th>1a. Assignments Randomized</th>
<th>1b. Similar Groups at Baseline</th>
<th>2a. Groups Treated Equally</th>
<th>2b. Dropouts Accounted For</th>
<th>3. Objective Measures or Blinding</th>
<th>Can be Generalized</th>
<th>Feasible Treatment</th>
<th>Benefits Outweigh Harms</th>
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<td>da Luz et al&lt;sup&gt;17&lt;/sup&gt;</td>
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<td>Ferreira et al&lt;sup&gt;21&lt;/sup&gt;</td>
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N/A due to only one group within each trial being utilized for this meta-analysis
Table 6. PEDro Scale

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<th>Author</th>
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<th>Random Allocation</th>
<th>Concealed Allocation</th>
<th>Baseline Comparability</th>
<th>Blind Subjects</th>
<th>Blind Therapists</th>
<th>Blind Assessors</th>
<th>Adequate Follow-up</th>
<th>Intention-to-treat Analysis</th>
<th>Between-group Comparisons</th>
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<tr>
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<tr>
<td>da Luz et al(^{17}) (eq) + Bronfort et al(^{27})</td>
<td>0.06</td>
<td>-0.67</td>
<td>-0.31</td>
<td></td>
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<tr>
<td>Grand Total ES</td>
<td>-0.34</td>
<td>-0.63</td>
<td>-0.49</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Global Perceived Effect</strong></td>
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<tr>
<td>da Luz et al(^{17}) + Ferreira et al(^{21})</td>
<td>1.24</td>
<td>0.45</td>
<td>0.85</td>
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<tr>
<td>Miyamoto et al(^{9}) + Ferreira et al(^{21})</td>
<td>1.31</td>
<td>0.52</td>
<td>0.91</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Grand Total ES</td>
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<tr>
<td><strong>SF-36 Mental Components</strong></td>
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</tr>
<tr>
<td>Wajswelner et al(^{13})</td>
<td>0.23</td>
<td>-0.62</td>
<td>-0.19</td>
<td></td>
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</tr>
<tr>
<td>Natour et al(^{8}) + Bronfort et al(^{27})</td>
<td>0.59</td>
<td>-0.23</td>
<td>0.18</td>
<td></td>
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<tr>
<td>Grand Total ES</td>
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### Table 8. Psychometric Data for the FABQ in the CLBP Population

<table>
<thead>
<tr>
<th></th>
<th>FABQ-PA</th>
<th>FABQ-W</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Normative Data</strong>&lt;sup&gt;65&lt;/sup&gt;</td>
<td>Private insurance: 14.6 (5.9), worker’s compensation: 14.4 (6.6), significance: 0.77,</td>
<td>Private insurance: 12.9 (10.1), worker’s compensation: 23.3 (10.8), significance: &lt;0.001</td>
</tr>
<tr>
<td><strong>Test-retest Reliability</strong>&lt;sup&gt;66&lt;/sup&gt;</td>
<td>FABQ/pa ($r = 0.64; P \leq 0.01; Excellent$)</td>
<td>FABQ/w ($r = 0.80; P \leq 0.01; Excellent$)</td>
</tr>
<tr>
<td><strong>Interrater/Intrarater Reliability</strong>&lt;sup&gt;67&lt;/sup&gt;</td>
<td>ICC = 0.94</td>
<td></td>
</tr>
<tr>
<td><strong>Internal Consistency</strong>&lt;sup&gt;68&lt;/sup&gt;</td>
<td>FABQ-W: excellent consistency (Cronbach’s alpha = 0.84-0.92)</td>
<td>FABQ-PA: poor consistency (Cronbach’s alpha = 0.52-0.57)</td>
</tr>
<tr>
<td><strong>Criterion Validity (Predictive)</strong>&lt;sup&gt;68&lt;/sup&gt;</td>
<td>FABQ-W to pain disability (RDQ): adequate predictive value (standardized beta: 0.57)</td>
<td>FABQ-PA to pain disability (RDQ): adequate predictive value (standardized beta: 0.40)</td>
</tr>
<tr>
<td></td>
<td>FABQ-PA to trunk extension/flexion (TEF) torque: poor predictive value (standardized beta: -0.28)</td>
<td></td>
</tr>
<tr>
<td><strong>Minimally Clinically Important Difference</strong>&lt;sup&gt;67&lt;/sup&gt;</td>
<td>13-point change*</td>
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</table>

*established for LBP
FIGURES
Figure 1. Pilates’s bed spring use

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<th>3</th>
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<th>7</th>
<th>8</th>
<th>9</th>
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<tr>
<td>No Pain</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Most Pain</td>
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</table>

<table>
<thead>
<tr>
<th>0</th>
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<th>3</th>
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<tr>
<td>No Pain</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Most Pain</td>
</tr>
</tbody>
</table>

*Numeric Rating Scale*

<table>
<thead>
<tr>
<th>No Pain</th>
<th>Most Pain</th>
</tr>
</thead>
</table>

*Visual Analog Scale*

Figure 2. Pain rating scales
Figure 3. Selection process
Figure 4. Difference in pain scores from pre- to postintervention

Figure 5. Global perceived effect
Figure 6. SF-36 mental components

Figure 7. The roll up
APPENDICES
APPENDIX A: CLINICAL PRACTICE GUIDELINES LINKED TO THE INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY, AND HEALTH FROM THE ORTHOPAEDIC SECTION OF THE AMERICAN PHYSICAL THERAPY ASSOCIATION
<table>
<thead>
<tr>
<th>Intervention</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual therapy</td>
<td>Clinicians should consider utilizing thrust manipulative procedures to reduce pain and disability in patients with mobility deficits and acute low back and back-related buttock or thigh pain. Thrust manipulative and nonthrust mobilization procedures can also be used to improve spine and hip mobility and reduce pain and disability in patients with subacute and chronic low back and back-related lower extremity pain.</td>
</tr>
<tr>
<td>Trunk coordination, strengthening, and endurance exercises</td>
<td>Clinicians should consider utilizing trunk coordination, strengthening, and endurance exercises to reduce low back pain and disability in patients with subacute and chronic low back pain with movement coordination impairments and in patients post lumbar microdiscectomy.</td>
</tr>
<tr>
<td>Centralization and directional preference exercises and procedures</td>
<td>Clinicians should consider utilizing repeated movements, exercises, or procedures to promote centralization to reduce symptoms in patients with acute low back pain with related (referred) lower extremity pain. Clinicians should consider using repeated exercises in a specific direction determined by treatment response to improve mobility and reduce symptoms in patients with acute, subacute, or chronic low back pain with mobility deficits.</td>
</tr>
<tr>
<td>Flexion exercises</td>
<td>Clinicians can consider flexion exercises, combined with other interventions such as manual therapy, strengthening exercises, nerve mobilization procedures, and progressive walking, for reducing pain and disability in older patients with chronic low back pain and radiating pain.</td>
</tr>
<tr>
<td>Lower-quarter nerve mobilization procedures</td>
<td>Clinicians should consider utilizing lower-quarter nerve mobilization procedures to reduce pain and disability in patients with subacute and chronic low back pain and radiating pain.</td>
</tr>
<tr>
<td>Traction</td>
<td>There is conflicting evidence for the efficacy of intermittent lumbar traction for patients with low back pain. There is preliminary evidence that a subgroup of patients with signs of nerve root compression along with peripheralization of symptoms or a positive crossed straight leg raise will benefit from intermittent lumbar traction in the prone position. There is moderate evidence that clinicians should not utilize intermittent or static lumbar traction for reducing symptoms in patients with acute or subacute, nonradicular low back pain or patients with chronic low back pain.</td>
</tr>
<tr>
<td>Patient education and counseling</td>
<td>Clinicians should not utilize patient education and counseling strategies that either directly or indirectly increase the perceived threat or fear associated with low back pain, such as education and counseling strategies that (1) promote extended bed-rest or (2) provide in-depth, pathoanatomical explanations for the specific cause of the patient’s low back pain. Patient education and counseling strategies for patients with low back pain should emphasize (1) the promotion of the understanding of the anatomical/structural strength inherent in the human spine, (2) the neuroscience that explains pain perception, (3) the overall favorable prognosis of low back pain, (4) the use of active pain coping strategies that decrease fear and catastrophizing, (5) the early resumption of normal or vocational activities, even when still experiencing pain, and (6) the importance of improvement in activity levels, not just pain relief.</td>
</tr>
<tr>
<td>Progressive endurance exercise and fitness activities</td>
<td>Clinicians should consider (1) moderate-to-high intensity exercise for patients with chronic low back pain without generalized pain, and (2) incorporating progressive, low-intensity, submaximal fitness and endurance activities into the pain management and health promotion strategies for patients with chronic low back pain with generalized pain.</td>
</tr>
</tbody>
</table>
APPENDIX B: HENRY MADDEN LIBRARY DATABASES AND ELECTRONIC RESOURCES
A
ABI/Inform Complete
ABI/Inform Dateline [ProQuest]
ABI/Inform Global [ProQuest]
ABI/Inform Trade & Industry [ProQuest]
ACLS Humanities E-Book Project
ACM Digital Library
African American Periodicals, 1825-1995 [Newsbank/Readex]
AgEcon Search: Research in Agricultural and Applied Economics
AGRICOLA [EBSCO]
America: History and Life [EBSCO]
American Bibliography of Slavic and East European Studies (ABSEES) [EBSCO]
American Chemical Society Journals [Journal Package] American History in Video
American Institute of Physics [Partial Journal Package] (formerly Scitation)

Art Index Retrospective: 1929-1984 [EBSCO] **2 users** Artemis Literary Sources [Gale]
Artemis Primary Sources [Gale]
ARTFL - Dictionnaire historique et critique ARTFL - Encyclopédie de Diderot et d'Alembert ARTFL - FRANTEXT
ARTFL - French Women Writers
ARTFL - Journal de Trévoux
ARTFL - Le Grand dictionnaire historique
ARTFL - Opera del Vocabolario Italiano (OVI) Database
ARTFL - Provençal Poetry
ARTFL - Textes de Français Ancien (TFA) ARTstor
ASCE Library
ATLA Religion Database [EBSCO]

B
BBC Shakespeare (Ambrose Video)
Berg Fashion Library **1 user**
BIOSIS Citation Index (ISI Ver.3.0)
Book Review Digest Retrospective: 1905-1982 [EBSCO] **2 users**
Books available at the Library – Includes Electronic Books (Library Catalog)
Books available in 3-5 Days (LINK+)
Business Source Premier [EBSCO]

C
CAB ABSTRACTS [EBSCO] **2 users**
Current Contents Connect:
Engineering, Computing & Technology (ISI Ver.3.0)
Current Contents Connect: Life Sciences (ISI Ver.3.0) Current Contents Connect: Physical, Chemical & Earth Sciences (ISI Ver.3.0)
Current Contents Connect: Social & Behavioral Sciences (ISI ver.3.0)

D
Dance in Video [Alexander Street Press]
Data Citation Index [Web of Science] Derwent Innovations Index [Thomson ISI]
Dissertations and Theses Full Text [ProQuest] Drama Criticism [Gale]

E
Early American Newspapers, Series I, 1690-1876 [NewsBank/Readex]
Early English Books Online [Proquest]
ebrary Academic Complete
eCollections Henry Madden Library - ContentDM EconLit [EBSCO]
Education Index Retrospective: 1929-1983 [EBSCO] Education Research Complete [EBSCO]
eHRAF World Cultures
Eighteenth Century Collections Online [Gale] Emerald Fulltext [Emerald]
Encyclopédie de Diderot et d'Alembert [ARTFL] Energy Technology Data Exchange World Energy Database (ETDEWEB)
Engineering Village 2 ERIC [EBSCO]
Essay & General Literature Index Retrospective: 1900-1984 [ESBCO]
Ethnic NewsWatch [ProQuest] Europa World Year Book

F
Field Research Corporation -The Field Poll
Films on Demand
FindLaw
First Research
Foundation Directory Online
*Library Use Only* Foundation Grants to Individuals Online
*Library Access Only*
Fresno State Faculty Bibliography
Fresno State Office of Institutional Effectiveness Data and Research
FSTA - Food Science and Technology Abstracts [EBSCO]
**1 user**

G
Gale Virtual Reference Library [Gale/Cengage]
Garland Encyclopedia of World Music Online [Alexander Street Press]
GenderWatch [ProQuest]
GEOBASE (Engineering Village) GeoREF [EBSCO]
GeoREF in Process [EBSCO] Google Book Search
Google Image Search
Google News Archive
Google Scholar (through Proxy) GPO Access
Grant and Foundation Resources
GreenFILE [EBSCO/Free] Grove Music Online

H
Handbook of Latin American Studies
Historical Abstracts [EBSCO]

I
IBISWorld IEEE XPlore
Institute of Physics Journals {Partial Journal Package} Inter-University Consortium for Political and Social Research Data Holdings (ICPSR)
International Nuclear Information System (INIS)
J
Johns Hopkins Online Guide to Literary Theory and Criticism
JSTOR

L
LexisNexis Academic Universe
LGBT Life with Full Text [EBSCO]
Library, Information Science & Technology Abstracts - (LISTA) [EBSCO]

Linguistics and Language Behavior Abstracts [ProQuest]

Literature Resource Center [Gale]
Local Market Audience Analyst (SRDS Media Solutions)
–IE Only
Loeb Classical Library
Los Angeles Times (1985 - present) [Proquest] Lynda.com

M
MathSciNet
Medieval and Early Modern Sources Online (MEMSO) MEDLINE [ISI/Web of Knowledge]
MEDLINE Plus
Mental Measurements Yearbook with Tests in Print [EBSCO] **4 users** Merck Index Mergent Online
Middle and Junior High Core Collection (EBSCO) Middle Search Plus [EBSCO]
MLA International Bibliography [EBSCO] Morningstar Investment Research Center Music Index [EBSCO]
Music Online: Premium [Alexander Street Press]

N
National Center for Education Statistics (NCES) National Criminal Justice Reference System (NCJRS) National Technical Information Service (NTIS)
Nature [NPG]
SciFinder on the Web Registration [Chemical Abstracts]
Shakespearean Criticism [Gale]
Short Story Criticism [Gale]
SIAM Digital Library [Society for Industrial and Applied Mathematics]
Smithsonian Global Sound **3 users** Snapshots North America [ProQuest] Social Services Abstracts [Proquest]
Social Work Abstracts [EBSCO] **1 user**
Sociological Abstracts [Proquest]
Something About the Author [Gale]
Sourcebook of Criminal Justice Statistics SPORTDiscus [EBSCO]
SpringerLink Online {Partial Journal Package} Standard & Poor's NetAdvantage

T
Teacher Reference Center [EBSCO/Free]
Thesaurus Linguae Graecae: A Digital Library of Greek Literature
TOXNET: Toxicology Data Network
Twayne's Authors Series [Gale]
Twentieth-Century Literary Criticism [Gale]

U
U.S. Census Bureau Data Access Tools
Uniform Crime Reports [FBI]
USDA Economics Statistics & Market Information System

V
Value Line Investment Survey - Standard Edition
Vogue – The Vogue Archive [ProQuest]

W
Web of Science [ISI/Web of Knowledge]
Wiley Online Library {Partial Journal Package} WorldCat.org [OCLC]
WorldImages Kiosk
Worldwide Political Science Abstracts [Proquest]

Z
Zoological Record (ISI)
APPENDIX C: PEDRO SCALE
## PEDro scale

1. eligibility criteria were specified  
   - no □ yes □ where:

2. subjects were randomly allocated to groups (in a crossover study, subjects  
   were randomly allocated an order in which treatments were received)  
   - no □ yes □ where:

3. allocation was concealed  
   - no □ yes □ where:

4. the groups were similar at baseline regarding the most important prognostic  
   indicators  
   - no □ yes □ where:

5. there was blinding of all subjects  
   - no □ yes □ where:

6. there was blinding of all therapists who administered the therapy  
   - no □ yes □ where:

7. there was blinding of all assessors who measured at least one key outcome  
   - no □ yes □ where:

8. measures of at least one key outcome were obtained from more than 85%  
   of the subjects initially allocated to groups  
   - no □ yes □ where:

9. all subjects for whom outcome measures were available received the  
   treatment or control condition as allocated or, where this was not the case,  
   data for at least one key outcome was analysed by "intention to treat"  
   - no □ yes □ where:

10. the results of between-group statistical comparisons are reported for at least one  
    key outcome  
    - no □ yes □ where:

11. the study provides both point measures and measures of variability for at  
    least one key outcome  
    - no □ yes □ where:

The PEDro scale is based on the Delphi list developed by Verhagen and colleagues at the Department of  
Epidemiology, University of Maastricht (Verhagen AP et al (1998). The Delphi list: a criteria list for quality  
assessment of randomised clinical trials for conducting systematic reviews developed by Delphi consensus. Journal  
of Clinical Epidemiology, 51(12):1235-41). The list is based on "expert consensus" not, for the most part, on  
empirical data. Two additional items not on the Delphi list (PEDro scale items 8 and 10) have been included in the  
PEDro scale. As more empirical data comes to hand it may become possible to "weight" scale items so that the  
PEDro score reflects the importance of individual scale items.

The purpose of the PEDro scale is to help the users of the PEDro database rapidly identify which of the known or  
suspected randomised clinical trials (ie RCTs or CCTs) archived on the PEDro database are likely to be internally  
valid (criteria 2-9), and could have sufficient statistical information to make their results interpretable (criteria 10-11).  
An additional criterion (criterion 1) that relates to the external validity (or "generalisability" or "applicability" of the  
trial) has been retained so that the Delphi list is complete, but this criterion will not be used to calculate the PEDro  
score reported on the PEDro web site.

The PEDro scale should not be used as a measure of the "validity" of a study's conclusions. In particular, we caution  
users of the PEDro scale that studies which show significant treatment effects and which score highly on the PEDro  
grade do not necessarily provide evidence that the treatment is clinically useful. Additional considerations include  
whether the treatment effect was big enough to be clinically worthwhile, whether the positive effects of the treatment  
outweigh its negative effects, and the cost-effectiveness of the treatment. The scale should not be used to compare the  
"quality" of trials performed in different areas of therapy, primarily because it is not possible to satisfy all scale items  
in some areas of physiotherapy practice.
Notes on administration of the PEDro scale:

All criteria **Points are only awarded when a criterion is clearly satisfied.** If on a literal reading of the trial report it is possible that a criterion was not satisfied, a point should not be awarded for that criterion.

Criterion 1 This criterion is satisfied if the report describes the source of subjects and a list of criteria used to determine who was eligible to participate in the study.

Criterion 2 A study is considered to have used random allocation if the report states that allocation was random. The precise method of randomisation need not be specified. Procedures such as coin-tossing and dice-rolling should be considered random. Quasi-randomisation allocation procedures such as allocation by hospital record number or birth date, or alternation, do not satisfy this criterion.

Criterion 3 **Concealed allocation** means that the person who determined if a subject was eligible for inclusion in the trial was unaware, when this decision was made, of which group the subject would be allocated to. A point is awarded for this criterion, even if it is not stated that allocation was concealed, when the report states that allocation was by sealed opaque envelopes or that allocation involved contacting the holder of the allocation schedule who was "off-site".

Criterion 4 At a minimum, in studies of therapeutic interventions, the report must describe at least one measure of the severity of the condition being treated and at least one (different) key outcome measure at baseline. The rater must be satisfied that the groups' outcomes would not be expected to differ, on the basis of baseline differences in prognostic variables alone, by a clinically significant amount. This criterion is satisfied even if only baseline data of study completers are presented.

Criterion 5-7 **Blinding** means the person in question (subject, therapist or assessor) did not know which group the subject had been allocated to. In addition, subjects and therapists are only considered to be "blind" if it could be expected that they would have been unable to distinguish between the treatments applied to different groups. In trials in which key outcomes are self-reported (eg, visual analogue scale, pain diary), the assessor is considered to be blind if the subject was blind.

Criterion 8 This criterion is only satisfied if the report explicitly states both the number of subjects initially allocated to groups and the number of subjects from whom key outcome measures were obtained. In trials in which outcomes are measured at several points in time, a key outcome must have been measured in more than 85% of subjects at one of those points in time.

Criterion 9 **An intention to treat** analysis means that, where subjects did not receive treatment (or the control condition) as allocated, and where measures of outcomes were available, the analysis was performed as if subjects received the treatment (or control condition) they were allocated to. This criterion is satisfied, even if there is no mention of analysis by intention to treat, if the report explicitly states that all subjects received treatment or control conditions as allocated.

Criterion 10 A **between-group** statistical comparison involves statistical comparison of one group with another. Depending on the design of the study, this may involve comparison of two or more treatments, or comparison of treatment with a control condition. The analysis may be a simple comparison of outcomes measured after the treatment was administered, or a comparison of the change in one group with the change in another (when a factorial analysis of variance has been used to analyse the data, the latter is often reported as a group \( \times \) time interaction). The comparison may be in the form of hypothesis testing (which provides a "p" value, describing the probability that the groups differed only by chance) or in the form of an estimate (for example, the mean or median difference, or a difference in proportions, or number needed to treat, or a relative risk or hazard ratio) and its confidence interval.

Criterion 11 A **point measure** is a measure of the size of the treatment effect. The treatment effect may be described as a difference in group outcomes, or as the outcome in (each of) all groups. **Measures of variability** include standard deviations, standard errors, confidence intervals, interquartile ranges (or other quantile ranges), and ranges. Point measures and/or measures of variability may be provided graphically (for example, SDs may be given as error bars in a Figure) as long as it is clear what is being graphed (for example, as long as it is clear whether error bars represent SDs or SEs). Where outcomes are categorical, this criterion is considered to have been met if the number of subjects in each category is given for each group.
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**Julie Elaine Simonian**

Type full name as it appears on submission

**March 19, 2016**

Date