Chronic low back pain and postural rehabilitation exercise: a literature review

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Abstract: Chronic low back represents one of the major causes of disability worldwide. Our narrative review has the purpose of highlighting the evidence supporting the different rehabilitative techniques described for its management. In total, 26 studies were found suitable to be included in the review (14 articles about pilates, six about McKenzie (MK), one article about Feldenkrais, three about Global Postural Rehabilitation (GPR) and two about Proprioceptive Neuromuscular Facilitation). The effect of exercise therapy was examined for each single study through changes in the main clinical outcomes (pain, disability,) quality of life (QoL) and psychological aspects and the targeted aspects of physical function (muscle strength, mobility, muscular activity and flexibility). All the techniques are effective for the study groups with respect to the control groups in reducing pain and disability and improving the QoL and maintaining benefits at follow-up; pilates, Back School, MK and Feldenkrais methods reduce pain and are more efficient than a pharmacological or instrumental approach in reducing disability and improving all psychological aspects also. GPR shows long lasting results for the last outcome. To date, it is difficult to affirm the superiority of one approach over another. Further high quality research is needed to confirm the effect of these techniques, together with the use of more appropriate evaluation measures.

Keywords: chronic low back pain, aspecific chronic low back pain, McKenzie, Global Postural Rehabilitation, pilates, Feldenkrais, Alexander method, Mézières, Souchard

Introduction
Chronic low back pain (CLBP) is defined as a pain that persists for more than 3 months, or longer than the expected healing period; it represents one of the most common and costly musculoskeletal problems in modern society. CLBP is experienced by 70%–80% of adults at some time in their lives. Its management comprises a range of different intervention strategies including surgery, drug therapy and non-medical intervention like rehabilitation.

Among alternative rehabilitative techniques, it is known that the behavioral or biopsychosocial approach offers the foundation for a better insight into persistent pain. Within rehabilitation approaches to CLBP, the Back School (BS), consisting of training in group exercises, has proven its efficacy in many research studies. BS is effective not only in improving the quality of life (QoL) and reducing disability in low back pain (LBP) but also in improving mental well-being.

In regards to the treatment of CLBP, exercise therapy appears to be slightly effective in decreasing pain and improving function; exercise therapy encompasses heterogeneous...
interventions, ranging from aerobic exercises to muscle strengthening and flexibility and stretching exercises.\textsuperscript{7,8}

Many techniques can provide an important positive effect on posture through muscle strengthening, flexibility and stretching exercises. Several postural rehabilitation techniques used in CLBP are based on the concept of muscular kinetic chains – such as the Global Postural Rehabilitation method (GPR), while others are based on biomechanical approaches referring to the structure of lumbar intervertebral disc during flexion and extension movements, as the McKenzie method (MK).\textsuperscript{9,10} Undoubtedly, an abnormal posture which often occurs in patients with CLBP is characterized by mild modifications of the spine curves on the sagittal plane or by the appearance of scoliotic deviations.\textsuperscript{11,12} Moreover, in postural rehabilitation approaches, great importance is given to the patients’ breathing control and therefore, to the diaphragm muscle.\textsuperscript{13} Pilates, on the other hand, emphasize the importance of isometric reinforcement of muscles of core stability. Further, one of the aims of pilates is to strengthen and train the core reference muscles for the control of trunk motion in all three planes.\textsuperscript{14,15} On the other hand, the GPR and Souchard methods do not concentrate on a specific part of the body alone, but treat the whole body in a global way, at the same time granting an active role to the patient who is also a protagonist of his/her own recovery.\textsuperscript{16}

In the approach to reduce of LBP and for an easier management of chronic pain, recent guidelines recommend rehabilitative intervention in CLBP with strong evidence.\textsuperscript{17–22}

Specifically, the guidelines of the American College of Physicians associate good efficacy of Yoga postures, Tai-chi exercises and the pilates method with recommendations of therapeutic exercises; the Nice guidelines also recommend core stability exercises, the MK method, the Feldenkrais method, the hydro-kinesio-therapy and aerobic exercises, while the approach of the Alexander method appears to be of less efficacy in CLBP.\textsuperscript{17,19} The aim of this narrative review is to provide the efficacy of different postural exercise interventions in reducing pain severity and their impact on function, QoL and healthcare use.

However, despite recommendations in postural exercise guidelines, there are no specific indications for clinicians in the choice of the most suitable postural technique or in the duration and the way of prescription of these exercises.

\textbf{Materials and methods}

A narrative review of the literature was performed using the following search engines: PubMed, Cochrane, Pedro and Scopus.

In order to perform the search, these keywords were used: Chronic Low Back Pain, Aspecific Chronic Low Back Pain AND/OR McKenzie, AND/OR Back School, AND/OR Global Postural rehabilitation, AND/OR GPR, AND/OR pilates, AND/OR Feldenkrais, AND/OR Alexander Method, AND/OR Mézières, AND/OR Souchard.

Inclusion criteria were articles published in the last 5 years, randomized clinical trial, the mean age of patients between 18 and 70 years and full English text. Exclusion criteria were observational studies, case reports and articles without abstract or full text, CAM therapy and different rehabilitative approaches. Articles published between 2012 up to 2017 were included in the research. The flow-diagram showing the selection of studies is given in Figure 1. The outcomes that were used to review included: chronic pain, disability, QoL and psychological aspects.

\textbf{Results}

In total, 26 articles satisfied the inclusion criteria and were considered in the review: 14 articles on the pilates approach, six articles treating the MK method, three articles about GPR, one article concerning the Feldenkrais technique. In Table 1 a summary of articles included in the search is present, comparing different patient samples, interventions and outcomes in treatment of CLBP.

\textbf{Discussion}

We have found no article about the Alexander method in the last 5 years. Concerning interventions with effect on proprioception, one article about Proprioceptive Neuromuscular Facilitation Integration Pattern (PNF) and one article about Proprioceptive Neuromuscular Facilitation (PNF) training were included in the review.\textsuperscript{44,45} No articles about Mézières were found in the research as a therapeutic solution of CLBP.

The results of the analyzed studies were grouped together considering the effects on these outcomes: chronic pain, disability and function, QoL and psychological aspects.

\textbf{Chronic pain}

Chronic pain is the most important symptom of CLBP. Therefore, it is very important to determine how to improve it. The visual analog scale (VAS) and the numerical rating scale (NRS) are the most used scales to define this symptom, but some studies also use the Oswestry Scale, the Quebec Scale and the McGill Pain Questionnaire.

The article by Ali Hasanpour-Dehkordi compares pilates and MK methods. In the MK group, participants performed 1-hour of workouts for 20 days while the pilates group
practiced sessions 3 times a week for 6 weeks and both were compared with CGs. After therapeutic exercises, no big difference in pain relief was found between the pilates group and the MK group ($P=0.327$) but an improvement in pain score was seen in both techniques when compared to the CG.\textsuperscript{16}

In Garcia’s article, the MK method is compared to BS. Exercises were performed once a week for 4 weeks but did not show a significant difference in reducing pain (average effect=0.66 points, 95% confidence interval [CI]=−0.29–1.62).\textsuperscript{23}

In the article by Valenza, pilates, twice a week for 8 weeks, was compared with normal daily living activities plus an informative text; the study showed significant differences in pain in the pilates group.\textsuperscript{24}

In the article by Garcia, two groups were compared; MK group and control group (CG), treated with pulsed ultrasound and short-wave diathermy. Both groups performed two sessions per week for 5 weeks. A better difference of one point was observed in pain intensity in the MK group.\textsuperscript{25}

Mohammad Hosseinifaret compared a MK group and a stabilization-exercises group. Both groups performed training sessions three times per week for 6 weeks. After therapeutic interventions, the pain score decreased in both groups.\textsuperscript{26}
Table 1  Summary of articles comparing different patient samples, interventions and outcomes for the treatment of CLBP

<table>
<thead>
<tr>
<th>Study</th>
<th>Patients</th>
<th>Intervention</th>
<th>Time of evaluation</th>
<th>Outcomes</th>
<th>Results/conclusion</th>
</tr>
</thead>
</table>
| Hasanpouri-Dehkordi et al (2017) | G1=McKenzie group (n=36)  
G2=pilates group (n=36)  
G0=control group (n=36) | G1=McKenzie exercises (1 h/day for 20 days)  
G2=1 h of pilates session (3 times/week for 6 weeks)  
G0=control group – no treatment | T0=baseline  
T1=6 weeks after randomization | Pain: McGill Pain Questionnaire  
QOL: General Health Questionnaire | Pain:  
G2=G1  
G2 and G1>G0  
QoL  
G2 and G1>G0  
G2>G1 |
| da Luz Jr et al (2013)         | G1=Mat pilates (n=43)  
G2=equipment-based pilates (n=43) | G1=pilates with mat, elastic bands and Swiss ball (12 sessions/6 weeks)  
G2=pilates with use of equipment such as cadillacs, ladder barrel and step (12 sessions/6 weeks) | T0=baseline  
T1=end of treatment  
T2=6 months follow up | Disability: RMDQ  
Pain: VAS  
Global perception: Global Perceived Effect Scale  
Specific disability: Patient-Specific Functional Scale  
Fear of moving: Tampa Scale | Disability:  
G2>G1  
G2 and G1>T0  
QoL  
G2>G1  
Trunk bending range G2>G1 |
| Garcia et al (2013)            | G1=Back School group (n=74)  
G2=McKenzie group (n=74) | G1=Back School exercises of mobility, flexibility and strength (1 time per week/4 weeks)+work at home  
G2=exercises according to the McKenzie method modifying postures and spinal motility range (1 time per week/4 weeks) | T0=baseline  
T1=end of treatment  
T2=3 months after randomization  
T3=6 months after randomization | Pain: VAS  
Disability: RMDQ  
Quality of life: World Health Organization Quality of Life-BREF instrument  
Trunk bending range: inclinometer | Pain:  
G2=G1  
Disability:  
G2>G1  
T0  
QoL  
G2>G1  
G2=G1 |
| Valenza et al (2017)           | G1=pilates group (n=27)  
G2=control group (n=27) | G1=pilates exercises of 45 minutes per session (2 times a week/8 weeks)  
G2=patients continued their usual activities and received a pamphlet on the right activities to be performed | T0=baseline  
T1=after intervention | Disability: RMDQ and Oswestry Disability Index  
Pain: VAS  
Flexibility: Finger-to-floor test  
Balance: Sing limb stance test  
Lumbar mobility: Modified Shober test | Disability:  
G1>G2  
G1>Trunk flexibility  
G1>Balance  
G1>Lumbar mobility  
G1=G2 |
| Garcia et al (2015)            | G1=McKenzie group (n=74)  
G2=placebo control group (n=74) | G1=30 minutes of McKenzie exercise (2 times per week/5 weeks)  
G2=detuned pulsed ultrasound and short-wave diathermy for 30 minutes per session (2 times per week/5 weeks) | T0=baseline  
T1=end of treatment  
T2=3 months from randomization  
T3=6 months from randomization  
T4=12 months from randomization | Pain: VAS  
Disability: RMDQ  
Global perception: Global Perceived Effect Scale  
Fear of moving: Tampa Scale | Pain:  
G1=G2  
Disability:  
G1=G2  
Global perception  
G1=G2  
Fear of moving G1=G2 |

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Table 1 (Continued)

<table>
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<tbody>
<tr>
<td>Hosseinifar et al (2013)²⁶</td>
<td>G1=McKenzie group (n=15) G2=stabilization exercises group (n=15)</td>
<td>G1=6 exercises: 4 types of extension and 2 types of flexion (3 times per week/6 weeks) G2=stabilization exercises divided into 6 steps (3 times a week/6 weeks)</td>
<td>T0=baseline T1=after intervention</td>
<td>Pain: VAS</td>
<td>G1=G2=G3</td>
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<td>Disability- function</td>
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<td>Functional Rating Index</td>
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<td>Thickness of transversus abdominal muscle and multifidus muscle: ultrasound</td>
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<tr>
<td>Mostagi et al (2015)²⁷</td>
<td>G1=pilates group (n=11) G2=general exercises group (n=11)</td>
<td>G1=pilates exercises (2 times a week/8 weeks) of 1 hour G2=stretching of the muscles of the trunk and lumbar region, spinal mobilizations, bicycle (2 times a week/8 weeks) of 1 hour</td>
<td>T0=baseline T1=end of treatment T2=3 months follow-up</td>
<td>Pain: VAS</td>
<td>G1=G2</td>
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<td>Function: The Quebec Back Pain Disability Scale</td>
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<td>Flexibility: ROM of the hip</td>
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<td>Back extensor resistance: Sorensen test</td>
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<tr>
<td>Franco et al (2017)²⁸</td>
<td>G1=active interventional current group + pilates (n=74) G2=placebo- interventional current group + pilates (n=74)</td>
<td>In the first 2 weeks patients were treated according to the group with the active interventional current (G1) or the placebo effect (G2) of it for 30 minutes. In the following 4 weeks, 40 minutes of pilates were added. The total number of sessions is 16 for 6 weeks</td>
<td>T0=baseline T1=end of treatment T2=6 months from randomization</td>
<td>Pain: Pain Numerical Rating Scale</td>
<td>G1=G2</td>
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<td>Threshold of pain: handheld pressure algometer</td>
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<td>Disability: RMDQ</td>
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<td>Fear of moving: Tampa Scale</td>
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<td>Specific disability: Patient-Specific Functional Scale</td>
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<td>Global perception: Global Perceived Effect Scale</td>
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<tr>
<td>Miyamoto et al (2013)²⁹</td>
<td>G1=pilates group (n=43) G2=no intervention group (n=43)</td>
<td>G1=pilates exercises (2 times a week for 6 weeks) G2=group that received an information sheet about chronic low back pain without any therapeutic activity</td>
<td>T0=baseline T1=end of treatment T2=6 months follow-up</td>
<td>Pain intensity: Pain Numeric Rating Scale</td>
<td>G1&gt;G2 (T1)</td>
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<td>Disability: RMDQ</td>
<td>G1=G2</td>
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<td>Specific functions: Patient-Specific Function Scale</td>
<td>G1=G2</td>
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<td>Global recovery perception: Global Perceived Effect Scale</td>
<td>G1=G2</td>
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<td>Fear of moving: Tampa Scale</td>
<td>G1=G2</td>
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<tr>
<td>Szulc et al (2015)³⁰</td>
<td>G1=McKenzie group + muscle energy technique (n=20) G2=McKenzie group (n=20) G3=group with standard exercises (n=20)</td>
<td>G1=exercises according to the McKenzie method, integrating with the muscle energy technique (10 sessions) G2=exercises according to the McKenzie method (10 sessions) G3=standard exercises that included classic massage, laser therapy and TENS applied to the lumbosacral region (10 sessions)</td>
<td>T0=baseline T1=end of treatment T2=3 months follow up</td>
<td>Pain: VAS and Oswestry pain</td>
<td>G1&gt;G2=G3</td>
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<td>Questionnaire</td>
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<td>Extension of spinal movements: electrogoniometry</td>
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<td>Structure of the spinal discs: magnetic resonance</td>
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<table>
<thead>
<tr>
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<th>Relevance/Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lawand et al (2015)</td>
<td>G1 = group (global postural rehabilitation) and stretching (12 weeks)</td>
<td>McKenzie method (12 sessions)</td>
<td>T0 = baseline</td>
<td>Pain: VAS</td>
<td>Recovery perception: functional mobility and balance, timed up and go test</td>
</tr>
<tr>
<td>Natour et al (2016)</td>
<td>G3 = group with exercises for motor control according to Hodges principles for a total of 12 sessions</td>
<td>G3 = group with modified pilates exercises</td>
<td>T2 = 2 months follow up</td>
<td>Pain: VAS</td>
<td>Recovery perception: functional mobility and balance, timed up and go test</td>
</tr>
<tr>
<td>Anand et al (2017)</td>
<td>G5 = group with exercises for motor control according to the McKenzie method</td>
<td>G5 = group with modified pilates exercises</td>
<td>T4 = 6 months follow up</td>
<td>Pain: VAS</td>
<td>Recovery perception: functional mobility and balance, timed up and go test</td>
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<tr>
<td>Kliziene et al (2015)</td>
<td>G6 = group with exercises for motor control according to the McKenzie method</td>
<td>G6 = group with modified pilates exercises</td>
<td>T5 = 9 months follow up</td>
<td>Pain: VAS</td>
<td>Recovery perception: functional mobility and balance, timed up and go test</td>
</tr>
<tr>
<td>Cruz Diaz et al (2015)</td>
<td>G7 = group with modified pilates exercises</td>
<td>G7 = group with modified pilates exercises</td>
<td>T6 = 12 months follow up</td>
<td>Pain: VAS</td>
<td>Recovery perception: functional mobility and balance, timed up and go test</td>
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</tbody>
</table>

Outcome measures:
- Depression Symptoms: Beck Depression Symptoms Scale
- QoL: SF-36 Quality of Life Questionnaire
- Disability: Oswestry index
- Pain: VAS Visual Analog Scale
- Physical activity: G0 = control group (no physical intervention), G1 = pilates group (2 times a week/6 weeks), G2 = no physical intervention (2 times a week/3 months), G3 = use of NSAIDs (4 or 5 people)

Relevance/Conclusion:
- Recovery perception: functional mobility and balance, timed up and go test
- Pain: VAS Visual Analog Scale
- QoL: SF-36 Quality of Life Questionnaire
- Depression Symptoms: Beck Depression Symptoms Scale
- Disability: Oswestry index
- Physical activity: G0 = control group (no physical intervention), G1 = pilates group (2 times a week/6 weeks), G2 = no physical intervention (2 times a week/3 months), G3 = use of NSAIDs (4 or 5 people)
### Table 1 (Continued)

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Adorno and Brasil-Neto (2013)</td>
<td>G1=iso-stretching group (n=10)</td>
<td>G1=isotonic and breathing exercises (2 times week/12 weeks)</td>
<td>T0=baseline T1=1 year follow up</td>
<td>Pain: VAS QoL: SF-36</td>
<td>G3&gt;G2&gt;G1</td>
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<td>G2=GPR group (global postural rehabilitation) (n=10)</td>
<td>G2=exercises for the muscles of the anterior hip static according to the GPR method (2 times per week/12 weeks)</td>
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<td>G1&gt;G2&gt;G3</td>
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<td>G3=ISO group+GPR (n=10)</td>
<td>G3=carried out once a week the GPR and twice a week the ISO for a total of 36 sessions in 3 months (24 ISO+12 GPR)</td>
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<tr>
<td>Castagnoli et al (2015)</td>
<td>G1=GPR group (n=51)</td>
<td>G1=postural exercises according to the Souchard method (2 times a week/8 weeks)</td>
<td>T0=baseline T1=1 year follow up</td>
<td>Pain: VAS Disability: RMQ</td>
<td>G1=G0 (T1)</td>
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<td>G0=control group with physiotherapy exercises (n=52)</td>
<td>G0=standard exercises following international guidelines (2 times a week/8 weeks)</td>
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<td>G1&gt;G0 (T2)</td>
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<td>Disability G1=G0 (T1–T2)</td>
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<td>Paolucci et al (2017)</td>
<td>G1=Feldenkrais group (n=26)</td>
<td>G1=exercises according to the Feldenkrais method, which is based on the self-awareness through movement (2 times a week/5 weeks)</td>
<td>T0=baseline T1=3 months follow up</td>
<td>Pain: VAS scale and MGPQ Disability: Waddel disability index QoL: SF-36 Mental-body interaction: MAIA</td>
<td>G1=G0 (VAS-MGPQ)</td>
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<td>G2=Back School group (n=27)</td>
<td>G2=Back School exercises with diaphragmatic breathing, elongation of the trunk muscles, strengthening of the vertebral column, abdominal and postural exercises (2 times a week/5 weeks)</td>
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<td>Disability G1=G0</td>
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<td>G1&gt;G0</td>
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<td>G1&gt;ISO (GPR)</td>
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<tr>
<td>Cruz-Diaz et al (2017)</td>
<td>G1=pilates group (n=34)</td>
<td>G1=divided into two subgroups: Mat pilates (G1-A) and equipment based pilates (G1-B) (12 weeks of treatment)</td>
<td>T0=baseline T1=6 weeks T2=12 weeks</td>
<td>Disability: RMQ Pain: VAS Fear of moving: Tampa Scale Transversus abdominal activation: ultrasound</td>
<td>G1-A+G1-B&gt;G0</td>
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<tr>
<td></td>
<td>G0=control group (n=34)</td>
<td>G0=no treatment</td>
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<td>G1-B had faster effects than G1-A</td>
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<tr>
<td>Kofotolis et al (2016)</td>
<td>G1=pilates group (n=37)</td>
<td>G1=Mat pilates exercises with a progression of intensity over the weeks (3 times a week/8 weeks)</td>
<td>T0=baseline T1=1 month follow up T2=3 months follow up</td>
<td>QoL: SF-36 and HRQOL Disability: RMQ</td>
<td>G2=G1 and G0</td>
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<td>G2-group with trunk strengthening exercises (n=36)</td>
<td>G2=abdominal strengthening exercises and stretching (3 times a week/8 weeks)</td>
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<td>Disability G1&gt;G2+G0</td>
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<td>G0=control group (n=28)</td>
<td>G0=did not perform exercises</td>
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**Table I (Continued)**

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<thead>
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</table>
| Murtezani et al (2015)²³     | G1=electro-physical agents (n=137)             | G1=exercises according to the McKenzie method for a maximum of 7 sessions in 4 weeks  
G2=use of interferential current, ultrasound and thermotherapy for 10 sessions in 4 weeks | T0=baseline T1=end of treatment T2=2 months follow-up T3=3 months follow-up | Pain: VAS  
Disability perception:  
Oswestry Low Back Pain  
Disability Questionnaire  
Trunk flection: fingertip to floor distance test | G1=G2  
G1-G2  
G1-G2  
G1-G2 |
| Wajswelner et al (2012)²⁵    | G1=pilates group (n=43) G2=general exercises group (n=32) | G1=participants of the pilates group received an individualized program of specific exercises with equipment (2 times a week/6 weeks)  
G2=the general training group received a generic set of exercises that were multidirectional and non-specific (2 times per week/6 weeks) | T0=baseline T1=end of treatment T2=12 weeks follow up T3=24 weeks follow up | Pain: Disability: Quebec Scale  
Specific Disability:  
Patient-Specific Functional Scale  
Pain perception:  
Self-efficacy questionnaire  
Global Perception: 5 scores scale  
QoL  
SF-36 | G1-G2  
G1-G2  
G1-G2  
G1-G2  
G1-G2  
G1-G2  
G1-G2  
G1-G2 |
| Marshall et al (2013)²⁷      | G1=trunk exercises group (n=43) G2=stationary cyclic exercises group (n=32) | G1=pilates exercises that require stability, strength and flexibility, with attention to muscle control, posture and breathing (3 times a week/8 weeks)  
G2=group 2 performed exercises known as Pedal pilates (3 times a week/8 weeks) | T0=baseline T1=end of treatment T2=6 months follow up | Pain: VAS  
Disability: Oswestry Low Back Pain Disability index  
Pain perception:  
Fear-Avoidance Beliefs Questionnaire  
Self perception:  
Pain/disability | G1-G2  
G1-G2  
G1-G2  
G1-G2  
G1-G2 |
| Young et al (2015)²⁹         | G1=PIP exercises training group (n=24)  
G2=Swiss ball exercises group (n=24) | G1=PNF-applied cross training program (50 minutes/day, 3 times/week for 6 weeks)  
G2=balance training exercises on Swiss ball (50 minutes/day, 3 times/week for 6 weeks) | T0=baseline T1=end of treatment | Balance:  
Mean velocity in the X and Y directions  
Functional Reach Test  
Timed up and go Test  
Pain: VAS | G1-G2T1  
G1-G2T1  
G1-G2T1  
G1-G2T1  
G1-G2T1  |
| Areeudomwong et al (2017)³⁰  | G1=PNF group (n=21) G2=control group (n=21) | G1=PNF training 5 times/week for 4 weeks, with each session lasting about 30 minutes 3 sets of 15 repetitions for each PNF intervention  
G2=low back pain educational booklet with active self-management training | T0=baseline T1=end of treatment (4 weeks) T2=12 weeks follow-up | Pain intensity:  
11-point NRS  
Functional Disability  
RMDQ (Thai)  
Treatment Satisfaction  
Global Perceived Effect Scale  
HRQOL  
SF-36v2 (Thai)  
PCS, MCS  
Back muscle activity  
Electromyographic activity of lumbar erector spiniae muscle | G1-G2  
G1-G2  
G1-G2  
G1-G2  
G1-G2  
G1-G2  
G1-G2  
G1-G2  
G1-G2  |

**Abbreviations:** BREF, World Health Organization WHOQOL-BREF Quality of Life; G, group; GPR, global postural rehabilitation; h, hour; HRQOL, Health-Related Quality of Life; ISO, isostretching; MAIA, Multidimensional Assessment of Interceptive Awareness; MCS, Mental Component Summary; MGPQ, McGill Pain Questionnaire; SF NRS, Short Form Numerical Rating Scale; NSAIDs, nonsteroidal anti-inflammatory drugs; PCS, Physical Component Summary; PIP, proprioceptive neuromuscular facilitation integration pattern; PNF, proprioceptive neuromuscular facilitation; QoL, quality of life; RMDQ, Roland-Morris Disability Questionnaire; RMQ, Roland-Morris Questionnaire; ROM, range of motion; SF-36, Short Form (36) Health Survey; SF-36v2, Short Form Health Survey version-2.0; T, time of evaluation; TENS, transcutaneous electrical nerve stimulation; VAS, visual analog scale.
Fernanda Queiroz Ribeiro Cerci Mostagi compared pilates and general exercises; patients were treated with pilates or with general exercises (stretching of the trunk and lumbar muscles, spinal mobilizations, cycling). Both groups performed two sessions per week for 8 weeks. No major differences in pain were found between pilates techniques and general exercises.27

One article by Katherine Moura Franco evaluated pilates vs physical therapy devices. This trial included an active interferential current group combined with pilates (n=74) and a current interferential group sham addicted to pilates (n=74). These findings suggested that the active interferential current group prior to pilates exercise was not more effective than placebo.28

Gisela C Mijamoto examined the efficacy of modified pilates exercises with training sessions two times a week for 6 weeks. Improvements in pain were observed in pilates group, but these differences were no longer statistically significant at 6 months.29

In the article by Pawel Szulc, 20 participants were divided in three groups, MK group combined with muscle energy technique, MK group and standard exercises group, with each group performing ten sessions. The MK method enriched with muscular energy technique had the best results in reducing pain.30

Jamil Natour considered a CG with patients taking nonsteroidal anti-inflammatory drugs (NSAIDs) and the intervention group (IG) where pilates was used twice a week for 3 months in addition to NSAIDs. Pain improved in the IG also less NSAIDs than the CG.31

In the article by David Cruz-Diaz, two groups of Spanish women over 65 were assigned to pilates in addition to standard therapy (n=50) and to standard therapy (transcutaneous electrical nerve stimulation, massage and stretching of the lumbar anatomical region) (n=47) only. Both groups performed two sessions per week for 6 weeks. The pilates group with added standard physiotherapy had better results in pain compared to the standard physiotherapy group measured with VAS.32

Irina Klziiene examined a pilates group (two times a week for 16 weeks) vs a no-IG. Pain was measured with VAS. At the end of the program, pain intensity decreased by 2.01±0.8 (P<0.05) in the pilates group, persisting for 1 month after the end of program.33

Another significant article by U Albert Anand compared 30 patients with modified pilates (modified lateral kick, modified shoulder bridge, swimming, modified swan dive, modified torsion) and another group with standard exercises (bridge pelvic, straight lifting, dynamic strengthening, stationary bicycle and coordination with the Swiss ball). Both groups performed twelve sessions. The results showed that pain and disability appeared much improved in the modified pilates group.34

In the article by Mark H Halliday, the MK method was compared with motor control exercises. Twelve sessions were performed over an 8-week period. No significant differences between the groups were found concerning pain or function (P=0.99 and P=0.26, respectively); the only outcome on behalf of the MK group was the perception of pain.35

The article by Priscila Lawand presents the IG compared with a CG. The IG performed postural exercises using the Souchard method and stretching (12 weeks of treatment+12 without treatment), while the CG did not perform physical intervention but used drugs only. The IG group demonstrated significant improvements (P<0.05) of pain.36

The article by Marta Lúcia Guimarães Resende Adorno evaluated isostretching effectiveness by dividing patients into three groups: isostretching group, GPR group and isostretching group with GPR additionally. All three groups performed training sessions twice a week for 6 weeks. Results indicated that physical therapies were effective in reducing pain (P<0.001); in the isostretching combined with GPR group, pain reduction was significantly greater. Moreover, in the follow-up evaluation, the GPR method was more efficient than other approaches.37

In the study by Chiara Castagnoli, GPR (Souchard) was compared with standard exercises performed twice per week for 8 weeks. This study showed how both groups registered significant improvements, but the GPR group maintained good results even at 1 year follow-up.38

A research by Paolucci Teresa considered Feldenkrais technique vs BS. Both groups performed two weekly sessions for 5 weeks. Both groups experienced significant changes in pain (P<0.001) during follow-up, demonstrating that Feldenkrais method has efficacy comparable to that of BS in improving CLDP.39

The article by David Cruz-Diaz reported the comparison between an IG (pilates) and a CG (no intervention). The pilates group was again divided into two groups: Mat pilates and Equipment-based pilates. Patients performed 12 weeks of training. Both Equipment-based pilates and Mat pilates approaches were more effective than no intervention approach in determining pain improvement.40

In the article by Ardiana Murtezani, the MKMethod was compared with electrophysical agents (EPAs: heat, ultrasound, interferential current). Participants were eligible for treatments in both groups; the first included 134 participants, the second 137. A greater improvement was noticed in the MK group a than in the EPAs group in VAS.41
Furthermore, we analyzed an article by Henry Wajswelner where pilates group and a general exercise group were compared. Both groups performed two training sessions per week for 6 weeks. Results showed that the individual pilates program produced similar benefits in pain scores as benefits gained with standard exercises.42

For Paul WM Marshall, patients were assigned in a group that underwent trunk exercises (stability, strength and flexibility, attention to muscle control, posture and breathing) (n=32) and a group treated with stationary cyclic exercises (Pedal pilates) (n=32). Both groups performed sessions three times per week for 8 weeks. Similar reductions in pain perception were observed in both groups at each point of time follow-up.43

In the article of Young et al (2015), a PIP (PNF-applied cross training program) was compared with Swiss ball training with a random allocation in two groups of elderly patients with CLBP pain. The training was performed for 50 minutes per day, three times a week for 6 weeks. Outcomes measured were Balance (mean velocity in the X and Y directions, functional reach test, timed up and go test) and Pain (VAS). The PIP and Swiss ball exercise groups exhibited a significant reduction in the VAS score from prior to after the exercise, but no significant difference between groups was observed. Therefore, PIP showed significant improvements in balance ability and pain for elderly persons with chronic back pain.44

Areu dendjwong P et al (2016) have investigated the persistence of the effects of PNF training on pain intensity, functional disability, patient satisfaction, health-related quality of life (HRQOL) and lower back muscle activity in patients with CLBP. All the outcomes were measured before and after the intervention, and at 12 weeks of follow up. Compared to CG, both at 4-weeks and at 12 weeks follow up, PNF patients showed a significant reduction in pain intensity, better results in functional disability, HQoRL and back muscle activity. These findings confirm that PNF training provides positive long-term effects on pain-related outcomes and increases lower back muscle activity in patients with CLBP.45

Disability and function

Disability is another main topic of most articles examined; it is most often measured with Roland-Morris Disability Questionnaire and Oswestry Disability Index, and sometimes also with Waddell Disability Index and Patient-Specific Functional Scale.

The study of Maurcio Antonio da Luz showed, at the last follow-up (T2), a significant difference in disability scores (mean value=3.0 points, 95% CI=0.6–5.4), specific disability (mean difference= 1.1 points, 95% CI=−2.0 to −0.1) and fear of moving (average mean=−4.9 points, 95% CI=1.6–8.2) in favor of Pilates group.46

In the article of Garcia, the MK group showed a significant improvement to 1-month disability (mean effect=2.37 points, 95% CI=0.76–3.99).25

For Valenza, results showed significant differences in the Pilates group regarding scores in disability; Roland-Morris Disability Questionnaire between groups means a difference of 3.2±4.12, *P*=0.003 and the Oswestry scale improved too (*P*=0.001).24

In the article by Garcia, difference offour points in Disability in the MK group was observed.25

Katherine Moura Franco did not find differences between active interventional current prior to exercise of Pilates and placebo compared to outcomes evaluated with Roland-Morris Disability Questionnaire in patients with nonspecific CLBP.23

Gisela C Mijamoto noted a disability improvement in modified pilates group, but these differences were no longer statistically significant at 6 months.29

Jamil Natour found that Pilates exercises in addition to NSAIDs were found favorable with regard to functional capacity.31

In the article by David Cruz Diaz, results showed that only the group of Pilates plus physiotherapy standard improved in fear of falling, functional mobility and balance after treatment.32

U Albert Anand observed that pain and disability appeared much improved in the modified Pilates group.34

Priscila Lawand’s article demonstrated that the IG group had significant improvements (*P*<0.05) in pain and disability to T1.36

In the study by Teresa Paolucci, both groups experienced significant changes in disability (*P*<0.001) along follow-up.39

In the article by David Cruz-Diaz, a major improvement was observed in the equipment-based Pilates group (*P*=0.007 determining a faster and greater transversus abdominis activation (*P*<0.001) as well as in pain and disability (*P*<0.001).40

In the article of Nikolaos Kofotolis et al, the results showed that Pilates participants reported greater improvements in disability and an effectiveness maintenance of 3 months.47

In the article by Ardiana Murtezani, a greater improvement was noted in the McKenzie group than in the EPAs group in Oswestry Low Back Pain Disability Questionnaire.41

The article by Henry Wajswelner showed how the individual Pilates program produced similar beneficial effects in disability and pain scores when compared to nonspecific exercises.42
QoL and psychological aspects

In the examined articles the importance of QoL and psychological aspects of examination in CLBP are evident. Above all, there are many studies that link CLBP and depression or other aspects that are intimately correlated to pain perception. On the other hand, Marshall et al emphasize on the psychosocial components of pain for complementing and improving the response to physical activity interventions and confirming the fear-avoidance model used to explain the relationship between pain and disability.37

For this reason our search is also focused on QoL (evaluated with HRQOL Scale, Short Form (SF)-36, General Health Questionnaire, World Health Organization QoL -BREF instrument), global perception (evaluated with Global Perceived Effect Scale), specific disability (Patient-Specific Functional Scale), fear of moving (Tampa Scale, Falls efficacy scale-international), function perception (Patient-Specific Functional Scale, Global Perceived Effect questionnaire), Depression symptoms (Beck Inventory Scale) and mental-body interaction (Multidimensional Assessment of Interoceptive Awareness-MAIA).

The research by Mauricio Antonio da Luz Jr. showed, in T2, a significant difference in fear of moving (average mean=−4.9 points, 95% CI=1.6–8.2) in favor of pilates group.36

In the article by Alessandro Narciso Garcia, QoL improved in the MK group more than in the BS group.25

Katherinne Moura Franco did not find any difference between pilates with or without interferential current.

Gisela C Mijamoto examined the efficacy of modified pilates exercises; improvements were also observed in overall impression of recovery in the pilates group measured with Global Perceived Effect Scale and Tampa Scale.28,29

In the article by David Cruz Diaz, results showed that only the pilates group with addition of physiotherapy standard improved in fear of falling.32

In the article by Mark H Halliday, the perceived recovery was slightly higher in the MK group (−0.8; 95% CI: −1.5, −0.1) on a scale of −5 to +5.35

The article by Priscyla Lawand demonstrated significant improvements (P<0.05) for pain and disability in the group with GPR approach, improving emotional aspects, limitation in physical functioning, vitality and mental health in SF-36.36

A research by Teresa Paolucci showed how BS and Feldenkrais method had the same efficacy on QoL and Mental-Body interaction.39

In the article of David Cruz Diazonly, the group of pilates with addition of standard physiotherapy improved in the fear of falling.32

In the Nikolaos Kofotolis’ article, the results showed that pilates participants reported greater improvements in HRQOL (P<0.05) compared to participants that did trunk strengthening exercises (G2) or that didn’t perform any exercise (G0). The effects were maintained for 3 months after the end of the program.47

We analyzed the article by Henry Wajsweiner where results showed how the individual pilates program produced similar function and QoL improvement compared to patients treated with standard exercises.42

For Paul WM Marshall, both groups (trunk exercises and Pedal pilates) performed sessions three times a week for 8 weeks. Similar reductions in pain perception were observed in both groups at each point of time during follow-up.43

Conclusion

Till date, based on what we know from literature, this is the first recent study that has tried to compare various postural methods. Of course, it must be taken into account as already mentioned, that ours is a narrative review that has not allowed us to statistically weigh the present studies in literature, but only to highlight the state of literature regarding this field.

However, in clinical practice, the results of this study could be useful to clarify which approach is most appropriate in the management of chronic back pain considering the different therapeutic and beneficial effects of the methods discussed.

We conclude that all the analyzed techniques have proved their efficacy with respect to the CG, but it is difficult to affirm the superiority of one approach as compared to another; they are more or less equivalent in reducing pain, reducing disability and improving the QoL. Some of the studies reported in this review included CG of patients who did not perform any rehabilitative treatment;16,19,31,33,40,47 other studies used the patient’s delivery of an information booklet about home-based exercises or ergonomic advises. These research studies concluded about a non-resolution of CLBP in the untreated group, that the natural history of progression of untreated lumbar chronic pain is to remain so with peaks of recurrences and a floating but unresolved pain. We can generally observe that the pilates, the MK method, the Feldenkrais method and BS improve the pain and are more efficient than just a generic, pharmacological or instrumental approach.24–26,30,33,34,36,41 Furthermore, stud-
ies using pilates technique have shown a good efficacy in improving chronic pain and physical function. We can also observe the same results in reducing disability and improving all psychological aspects we mentioned related to CLBP. Even GPR, in three articles, has shown very good results in follow-ups at 6 months and up to 1 year.36–38 Furthermore, the Mézières technique should be investigated because there are no randomized clinical trials or studies. Concerning PNF techniques, further investigations are needed in order to confirm their efficacy although results of reported studies are promising because of their multiple effects. Finally, as can be observed in the mentioned studies, BS technique has shown good results in patient education and improving QoL and in managing pain.

We think that further scientific research is needed to strengthen the efficacy of the different techniques and to support an evidence-based approach to CLBP.

**Disclosure**

The authors report no conflicts of interest in this work.

**References**


