Journal of Pain Research

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REVIEW

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

This article was published in the following Dove Press journal:
Journal of Pain Research

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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.[2] CLBP is experienced by 70%–80% of adults at some time in their lives.[3] 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.[4]

Within rehabilitation approaches to CLBP, the Back School (BS), consisting of training in group exercises, has proven its efficacy in many research studies.[5] 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.[6]

In regards to the treatment of CLBP, exercise therapy appears to be slightly effective in decreasing pain and improving function; exercise therapy encompasses heterogeneous

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Dovepress
http://dx.doi.org/10.2147/JPR.S171729

interventions, ranging from aerobic exercises to muscle strengthening and flexibility and stretching exercises.[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).[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.[11,12] Moreover, in postural rehabilitation approaches, great importance is given to the patients' breathing control and therefore, to the diaphragm muscle.[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.[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.[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.[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.[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.

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.

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.

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 (PIP) and one article about Proprioceptive Neuromuscular Facilitation (PNF) training were included in the review.[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.

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

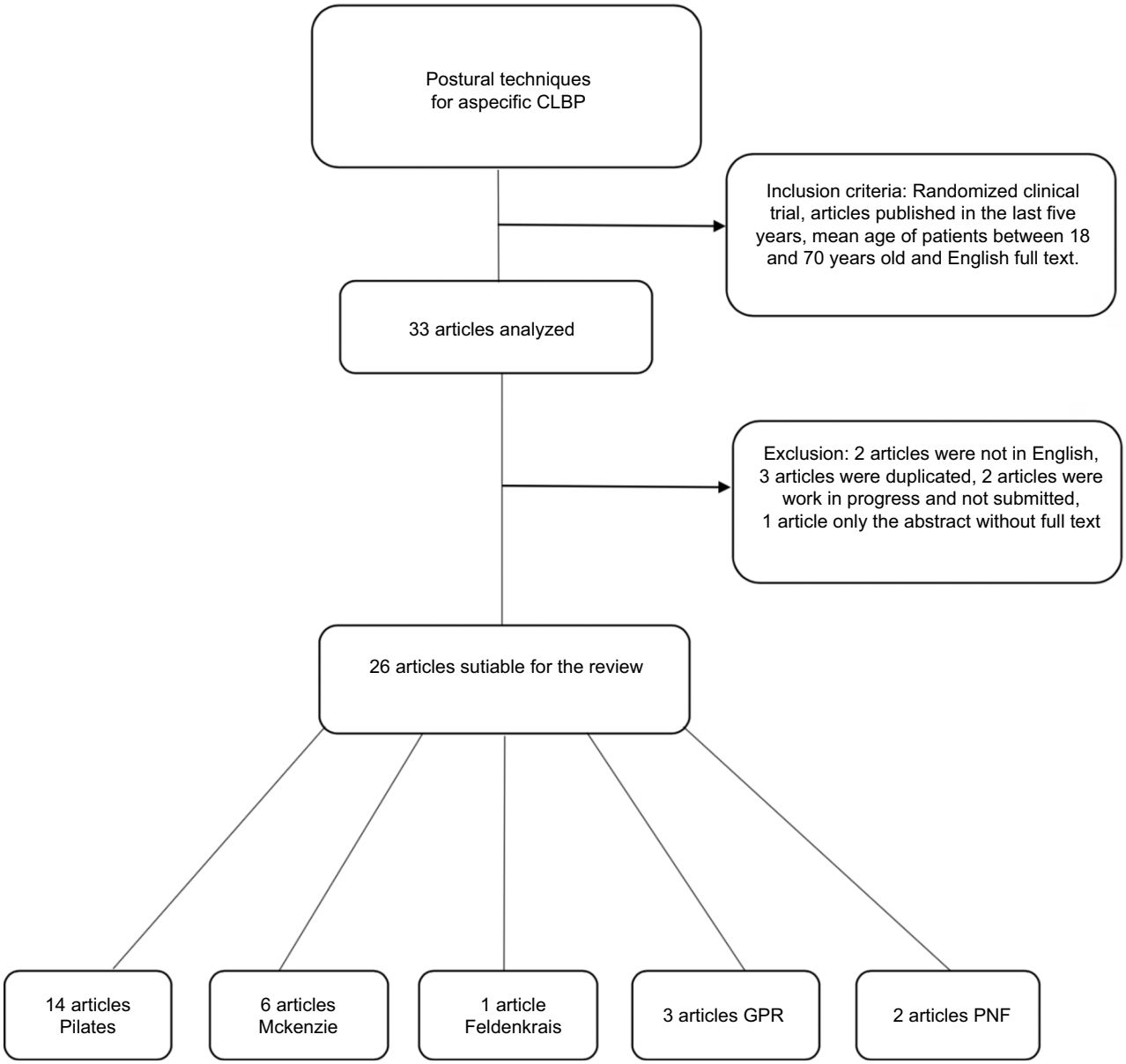

Figure 1 Flow diagram showing study selection.
Abbreviations: CLBP, Chronic low back pain; GRP, global postural rehabilitation; PNF, proprioceptive neuromuscular facilitation.

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.[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).[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.[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.[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.[26]

Table 1 Summary of articles comparing different patient samples, interventions and outcomes for the treatment of CLBP

Study	Patients	Intervention	Time of evaluation	Outcomes	Results/conclusion
Hasanpour-Dehkordi et al (2017)[16]	G1=McKenzie (n=36) G2=pilates (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)[46]	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 Pain G2=G1 Global Perception G2=G1 Specific Disability G2>G1 Fear of moving G2>G1
Garcia et al (2013)[23]	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 Trunk bending range G2=G1
Valenza et al (2017)[24]	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 Disabilty Index Pain: VAS Flexibility: Finger-to-floor test Balance: Sing limb stance test Lumbar mobility: Modified Shober test	Disability G1>G2 Pain G1>G2 Trunk flexibility G1>G2 Balance G1>G2 Lumbar mobility G1>G2
Garcia et al (2015)[25]	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

(*Continued*)

Table 1 (*Continued*)

Study	Patients	Intervention	Time of evaluation	Outcomes	Results/conclusion
Hosseinifar et al (2013)[26]	G1=McKenzie group (n=15) G2=stabilization exercises group (n=15)	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)	T0=baseline T1=after intervention	Pain: VAS Disability- function: Functional Rating Index Questionnaire Thickness of transversus abdominal muscle and multifidus muscle: ultrasound	Pain G2=G1 Disability- function G2>G1 Thickness of transversus abdominal muscle and multifidus muscle G2>G1
Mostagi et al (2015)[27]	G1=pilates group (n=11) G2=general exercises group (n=11)	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	T0=baseline T1=end of treatment T2=3 months follow-up	Pain: VAS Function: The Quebec Back Pain Disability Scale Flexibility: ROM of the hip Back extensor resistance: Sorensen test	Pain G1=G2 Function G2>G1 Flexibility G2>G1 Back extensor resistance G1=G2
Franco et al (2017)[28]	G1=active interferential current group+pilates (n=74) G2=placebo-interferential current group +pilates (n=74)	In the first 2 weeks patients were treated according to the group with the active interferential 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	T0=baseline T1=end of treatment T2=6 months from randomization	Pain: Pain Numerical Rating Scale Threshold of pain: handheld pressure algometer Disability: RMDQ Fear of moving: Tampa Scale Specific disability: Patient-Specific Functional Scale Global perception: Global Perceived Effect Scale	Pain G1=G2 Threshold of pain G1=G2 Disability G1=G2 Fear of moving G1=G2 Specific disability G1=G2 Global perception G1=G2
Miyamoto et al (2013)[29]	G1=pilates group (n=43) G2=no intervention group (n=43)	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	T0=baseline T1=end of treatment T2=6 months follow-up	Pain intensity: Pain Numeric Rating Scale Disability: RMDQ Specific functions: Patient-Specific Function Scale Global recovery perception: Global Perceived Effect Scale Fear of moving: Tampa Scale	Pain intensity G1>G2 (T1) G1=G2 (T2) Disability G1>G2 (T1) G1=G2 (T2) Specific functions G1=G2 Global recovery perception G1>G2 (T1) G1=G2 (T2) Fear of moving G1=G2
Szulc et al (2015)[30]	G1=McKenzie group+muscle energy technique (n=20) G2=McKenzie group (n=20) G3=group with standard exercises (n=20)	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)	T0=baseline T1=end of treatment T2=3 months follow up	Pain: VAS and Oswestry pain Questionnaire Extension of spinal movements: electrogoniometry Structure of the spinal discs: magnetic resonance	Pain G1>G2>G3 Extension of spinal movements G1>G2>G3 Structure of the spinal discs G1>G2>G3

(*Continued*)

Table 1 (*Continued*)

Study	Patients	Intervention	Time of evaluation	Outcomes	Results/conclusion
Natour et al (2015)[31]	G1=pilates+NSAIDs (n=30) G2=NSAIDs (n=30)	G1=exercises according to the pilates method with groups of 4 or 5 people (2 times a week/3 months) G2=no physical intervention	T0=baseline T1=half treatment T2=end of treatment T3=3 months follow up	Pain: VAS Function: RMQ QoL: SF-36 Treatment satisfaction: Likert scale Flexibility: sit and reach test NSAIDs intake	Pain G1>G2 Function G1>G2 QoL G1>G2 Treatment satisfaction G1>G2 Flexibility G1>G2 NSAIDs intake G1>G2
Cruz Díaz et al (2015)[32]	G1=standard physiotherapy+pilates (n=50) G2=standard physiotherapy (n=47)	G2=use of TENS, massage and stretching of low lumbar area (2 times a week/6 weeks) G1=standard physiotherapy+pilates (2 times a week/6 weeks)	T0=baseline T1=end of treatment	Fear of falling: Falls efficacy scale-international Functional mobility and balance: timed up and go test Pain: VAS	Fear of falling G1>G2 Functional mobility and balance G1>G2 Pain G1>G2
Kliziene et al (2017)[33]	G1=pilates group (n=27) G0=control group (n=27)	G1=pilates exercises (twice a week/16 weeks) G0=no treatment	T0=baseline T1=end of treatment T2=1 month follow up T3=2 months follow up	Power: isokinetic dynamometer Static resistance of the trunk muscles: test Pain: VAS	Power G1>G0 Static resistance of the trunk muscles G1>G0 Pain G1>G0
Anand et al (2014)[34]	G1=group with modified pilates exercises and flexibility exercises (n=15) G2=group with standard and flexibility exercises (n=15)	G1=modified pilates exercises such as modified side kick, modified shoulder bridge, swimming, modified swan dive, modified twist (12 sessions) G2=standard exercises such as pelvic bridge, straight lifting, dynamic strengthening, stationary bicycle and coordination with Swiss ball (12 sessions)	T0=baseline T1=end of treatment	Pain: VAS Disability: Oswestry index	Pain G1>G2 Disability G1>G2
Halliday et al (2016)[35]	G1=McKenzie group (n=35) G0=control group with exercises for motor control (n=35)	G1=exercises according to the McKenzie method for a total of 12 sessions divided into 8 weeks G0=exercises for motor control according to Hodges principles for a total of 12 sessions divided into 8 weeks	T0=baseline T1=end of treatment	Thickness muscles of the trunk: ultrasound Perception of the function: Patient-Specific Functional Scale Recovery perception: Global Perceived Effect questionnaire Pain: VAS	Thickness muscles of the trunk G1=G0 Perception of the function G1=G0 Recovery perception G1>G0 Pain G1=G0
Lawand et al (2015)[36]	G1=GPR group (global postural rehabilitation) (n=31) G0=control group (n=30)	G1=postures according to the Souchard method and stretching (12 weeks of treatment+12 without treatment) G0=use of drugs without physical activity	T0=baseline T1=3 months follow up T2=6 months follow up	Pain: VAS Disability: The Roland Morris Questionnaire QoL: SF-36 Depression Symptoms: Beck Inventory	Pain G1>G0 Disability G1>G0 QoL G1>G0 Depression Symptoms G1>G0

(*Continued*)

Table 1 (*Continued*)

Study	Patients	Intervention	Time of evaluation	Outcomes	Results/conclusion
Adorno and Brasil-Neto (2013)[37]	G1=isostretching group (n=10) G2=GPR group (global postural rehabilitation) (n=10) G3=ISO group+GPR (n=10)	G1=isotonic and breathing exercises (2 times week/12 weeks) G2=exercises for the muscles of the anterior hip static according to the GPR method (2 times per week/12 weeks) 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)	T0=baseline T1=end of treatment T2=2 months follow up	Pain: VAS QoL: SF-36	Pain G3>G2>G1 QoL G1>G2+G3
Castagnoli et al (2015)[38]	G1=GPR group (n=51) G0=control group with physiotherapy exercises (n=52)	G1=postural exercises according to the Souchard method (2 times a week/8 weeks) G0=standard exercises following international guidelines (2 times a week/8 weeks)	T0=baseline T1=end of treatment T2=1 year follow up	Pain: VAS Disability: RMQ	Pain G1=G0 (T1) G1>G0 (T2) Disability G1=G0 (T1–T2)
Paolucci et al (2017)[39]	G1=Feldenkrais group (n=26) G2=Back School group (n=27)	G1=exercises according to the Feldenkrais method, which is based on the self-awareness through movement (2 times a week/5 weeks) 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)	T0=baseline T1=end of treatment T2=3 months follow up	Pain: VAS scale and MGPQ Disability: Waddel disability index QoL: SF-36 Mental-body interaction: MAIA	Pain G1=G0 (VAS-MGPQ) Disability G1=G0 QoL G1=G0 Mental-body interaction G1=G0
Cruz-Díaz et al (2017)[40]	G1=pilates group (n=34) G0=control group (n=34)	G1=divided into two subgroups: Mat pilates (G1-A) and equipment based pilates (G1-B) (12 weeks of treatment) G0=no treatment	T0=baseline T1=6 weeks T2=12 weeks	Disability: RMQ Pain: VAS Fear of moving: Tampa Scale Transversus abdominal activation: ultrasound	Disability G1-A+G1-B>G0 G1-B had faster effects than G1-A Pain G1-A+G1-B>G0 G1-B had faster effects than G1-A Fear of moving G1-A+G1-B>G0 G1-B had faster effects than G1-A Activation of the transverse muscles G1-A+G1-B>G0 G1-B had faster effects than G1-A
Kofotolis et al (2016)[47]	G1=pilates group (n=37) G2=group with trunk strengthening exercises (n=36) G0=control group (n=28)	G1=Mat pilates exercises with a progression of intensity over the weeks (3 times a week/8 weeks) G2=abdominal strengthening exercises and stretching (3 times a week/8 weeks) G0=did not perform exercises	T0=baseline T1=end of treatment T2=1 month follow up T3=3 months follow up	QoL: SF-36 and HRQOL Disability: RMQ	QoL G2>G1 and G0 Disability G1>G2 e G0

(*Continued*)

Table 1 (*Continued*)

Study	Patients	Intervention	Time of evaluation	Outcomes	Results/conclusion
Murtezani et al (2015)[41]	G1=McKenzie group (n=134) G2=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 Disabilty Questionnaire Trunk flection: fingertip to floor distance test	Pain G1>G2 Disability perception G1>G2 Trunk flection G1>G2
Wajswelner et al (2012)[42]	G1=pilates group (n=44) G2=general exercises group (n=43)	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: Pain Self-efficacy questionnaire Global Perception: 5 scores scale QoL: SF-36	Pain/disability G1=G2 Specific disability G1=G2 Pain perception G1=G2 Global perception: G1=G2 QoL G1=G2
Marshall et al (2013)[43]	G1=trunk exercises group (n=32) 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: Pain Catastrophizing Scale Self perception: Fear-Avoidance Beliefs Questionnaire	Pain G1>G2 T1 G1=G2 T2 Disability G1>G2 T1 G1=G2 T2 Pain perception G1>G2 T1 G1=G2 T2 Self perception G1=G2
Young et al (2015)[44]	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	Balance G1-G2T1>G1-G2T0 G1=G2 T1 Pain G1-G2 T1>G1 G2 T0 G1=G2 T1
Areeudomwong et al (2017)[45]	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 spinae muscle	Pain G1>G2 T1 G1>G2 T2 Functional Disability G1>G2 T1 G1>G2 T2 Global Perceived Effect Scale G1>G2 T1 G1>G2 T2 PCS G1>G2 T1 G1>G2 T2 MCS: n.s. Back muscle activity G1>G2 T1 G1>G2 T2

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 Interoceptive 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 Katherinne 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 Kliziene 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]

Areeudomwong 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 ythat 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=000.3 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]

Katherinne Moura Franco did not find differences between active interferential current prior to exercise of pilates and placebo compared to outcomes evaluated with Roland-Morris Disability Questionnaire in patients with nonspecific CLBP.[28]

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 Maurcio 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.[46]

In the article by Alessandro Narciso Garcia, QoL improved in the MK group more than in the BS group.[23]

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 Priscila 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 Wajswelner 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 advices. 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.

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