



Pilates for low back pain: A systematic review

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A B S T R A C T

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Objective: The aim of this paper is to systematically review all controlled clinical trials of Pilates to treat low back pain.

Data sources: A systematic review of nine databases (Cochrane Central Register of Controlled Trials, MEDLINE, EMBASE, CINAHL, AMED, PsycINFO, Pedro, Rehadat, Rehab Trials) was conducted and the reference lists of all the papers were checked for further relevant publications until May 2010.

Study selection: A first selection was performed by means of title and abstract. A second selection was made by means of predefined inclusion criteria: randomized controlled clinical trials testing Pilates in patients of any age or sex with low back pain.

Data extraction: Data relating to changes in body function, quality of life and pain from the included studies were independently extracted by the reviewers on a standardized form. Study quality was assessed using the Oxford scale.

Data synthesis: Four eligible randomized controlled clinical trials ($n = 4$) involving Pilates for the management of low back pain were included. The methodological quality of the RCTs was relatively low, varying from 1–4 on the Oxford scale. All studies were heterogeneous in terms of population of patients, control groups, inclusion and exclusion criteria, and outcome measures making a meta-analysis not feasible. Although there is some evidence supporting the effectiveness of Pilates in the management of low back pain, no definite conclusions can be drawn except that further research is needed with larger samples and using clearer definitions of the standard care and comparable outcome measures.

Conclusions: There is a wide diversity in research investigating the clinical and cost-effectiveness of Pilates in patients with low back pain.

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1. Introduction

Chronic low back pain (LBP) is one of the commonest musculo-skeletal problems in modern society^{1,2} and is a highly prevalent and very expensive health dilemma.^{3–6} The aetiology of this disability is complex and multidimensional; however, physical and (partially) psychosocial occupational factors seem to play an important aetiological role.⁷ LBP is defined as pain localized between the twelfth rib and the inferior gluteal folds, with or without leg pain and in 90% of cases is non-specific.^{1,4,5} Other researchers conclude that is best defined as a low level continuous or essentially continuous lumbar, sacral or lumbosacral spinal pain that is punctuated by exacerbations of pain, each of which is characterized as 'acute'. Patients who experience this disability are limited in their daily living activities and may

experience inappropriate neuromuscular adaptations to maintain and/or preserve functions such as walking, running, or other activities.⁸ Potentially effective therapies for this disorder are appropriate education, i.e. Alexander Technique and cognitive-behavioural therapy; other alternative modalities such as hypnosis, biofeedback, relaxation, massage, spinal manipulation and traction treatment^{9,10}; and spinal stabilization exercises.¹¹ Some researchers suggest that weakened muscles such as the transversus abdominis (TA) and multifidius (MF) may be responsible for decreased spinal stability and consequently the onset of LBP^{12,13}. The Pilates method strengthens these muscles and hence may be an effective modality for LBP^{14,15}. The Pilates method was originally developed by Joseph Pilates during the First World War and since then it has brought new insight to lower back rehabilitation methods.¹⁶ Pilates' initial concept mixed elements of gymnastics, martial arts, yoga and dance, focusing on the relationship between the body and mental discipline.¹⁷ The goal of Pilates training is to improve general body flexibility and health, core strength and posture, and to coordinate movement with the breath.¹⁵

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To date, scientific evidence of the effectiveness of the Pilates method for the treatment of LBP is rather anecdotal¹⁸ and therefore the aim of this review is to systematically assess evidence of its efficacy in the treatment of low back pain from all controlled clinical trials.

2. Method

Literature searches were performed to identify all controlled clinical trials of Pilates as treatment for LBP. The following databases were used: Cochrane Central Register of Controlled Trials, MEDLINE, EMBASE, CINAHL, AMED, PsycINFO, Pedro, Rehadat, Rehab Trials and web pages such as clinicaltrials.gov, using the search terms 'low back pain', 'chronic', 'discogenic low back pain', 'non-specific low back pain', 'Pilates', 'rehabilitation' and 'physiotherapy' to identify all relevant published articles on the subject. The reference lists of the papers initially identified were scanned for further relevant literature. No language barriers were imposed.

3. Inclusion and exclusion criteria

All retrieved data including uncontrolled trials, case studies, pre-clinical and observational studies were reviewed for safety information. However, only randomized controlled clinical trials testing Pilates in patients of any age or sex with low back pain were included. Studies in any language published in peer-reviewed scientific journals between 1980 and 2010 were considered eligible.

3.1. Methodological quality of the studies

The quality of the studies was assessed using the five-point Oxford scale,¹⁹ which has good inter-examiner reliability.²⁰ This scale assesses methodological quality such as randomization and blinding procedures, descriptions of withdrawal and dropout rates, using a scale from 0 (poorest) to 5 (highest). Points were awarded as follows: study described as randomized, 1 point; appropriate randomization method, 1 additional point; inappropriate randomization method, deduct 1 point; patient blinded to intervention (patient blinding was assumed where the control intervention was indistinguishable from the treatment group), 1 point; evaluator blinded to intervention, 1 point; description of withdrawals and dropouts, 1 point. Clinical trials scoring 4 or 5 points were considered to be of high quality.

3.2. Data extraction and quality assessment

Initial screening of the abstracts of the studies was performed by two authors (PP, PL) independently. If it was not clear from the abstract whether or not the study should be included in the review, the full text of the article was assessed. All articles included were read in full. Data relating to sample size, diagnosis, gender of patients in the samples used, their previous incidences of LBP, therapeutic intervention and control, treatment time, primary (and secondary) outcome measures and results were extracted by the first author and validated by the second. The third reviewer (MHD) further validated data using a predefined standardized form. The authors met to come to a consensus and discrepancies were solved by discussion.

4. Results

The search strategy generated a total of 199 references, of which 51 were considered potentially relevant. We did not locate any unpublished trials, nor relevant papers published in any language other than English. A total of 11 clinical trials were retrieved for

further evaluation of which 4, involving 228 patients, were eligible for inclusion (see Fig. 1 diagram). Reasons for exclusion included no specific outcome measure, trials including patients with conditions other than LBP such as fibromyalgia syndrome, and trials that included healthy individuals only. For example, Culligan et al.¹⁴ and Sekendiz et al.'s¹⁶ studies were excluded because they did not include LBP patients; Kloubec's²¹ research was excluded as it considered healthy individuals only; Merrithew's study²² was excluded as it was not a randomized controlled trial; Da Fonseca et al.'s²³ study was excluded because pain was not the primary outcome measure; and Cairns et al.¹¹ and Hides et al.¹³ were excluded as their work was concerned with core stability exercises rather than Pilates *per se*.

4.1. Description of studies

Four studies meeting the criteria mentioned above were included.^{24–27} They originated from the UK,²⁵ the US,²⁷ Italy²⁴ and Canada.²⁶ Pilates was used in all four studies. LBP patient populations were heterogeneous, and the descriptions of pain included chronic pain, discogenic pain and non-specific back pain. Control groups were standard or usual care²⁶; Back School,²⁴ drug therapy with lumbar brace²⁷; and no intervention.²⁵ Table 1.

Gladwell et al. conducted an RCT to evaluate the effect of modified Pilates on 49 active individuals with chronic LBP.²⁵ Study participants were randomly allocated to a control or a Pilates group. Main outcome measures included (1) the visual analogue scale (VAS), (2) subjective improvement of symptoms, (3) an assessment of back-specific functional status. They report that Pilates was found to be superior to the controls and improvements were seen in this group's general health, sports functioning, flexibility and proprioception, and they experienced less pain. There are some limitations to this study: firstly, the randomization is not clearly described; secondly, it is single-blinded trial only; thirdly, no intention to treat analysis was performed; and fourthly, the sample was rather heterogeneous. The strengths of this trial include the good-quality statistical methods used and the adequate description of loss to follow-up rate. We gave this study a score of 3.

Donzelli et al. conducted a randomized controlled trial with 53 patients with non-specific LBP.²⁴ Patients entered either a Pilates therapy or a Back School treatment group. They used the Oswestry Low Back Pain Disability Scale (OLBPQ) and VAS and at six months no significant differences were found between the groups. Nonetheless, the Pilates method group showed better compliance and subjective response to treatment. Although this study is described as randomized, there is no specification at all of how the randomization and allocation to groups was performed. The blinding procedure is not adequately described, neither does the study elaborate on whether the statistical analysis was masked. Intention to treat analysis is not mentioned either. Another possible limitation of this study is the lack of statistical analysis between the intervention and control groups, with frequency tables and distribution of variables presented only. This study was given a score of 1; however, the dropout (loss to follow-up) rate and eligibility criteria were sufficiently described and the group was relatively homogeneous.

Rydeard et al.²⁶ conducted a randomized controlled trial to investigate the efficacy of the Pilates approach with 39 chronic low back pain (LBP) patients. Patients were randomly assigned to the Pilates group while the control group received 'the usual care'. They used Roland-Morris Disability Questionnaire (RMDQ) and NRS-101, a 101-point numerical rating scale assessing pain intensity. There was a significantly lower level of functional disability and average pain intensity in the specific exercise training group than in the control group following the treatment intervention period.

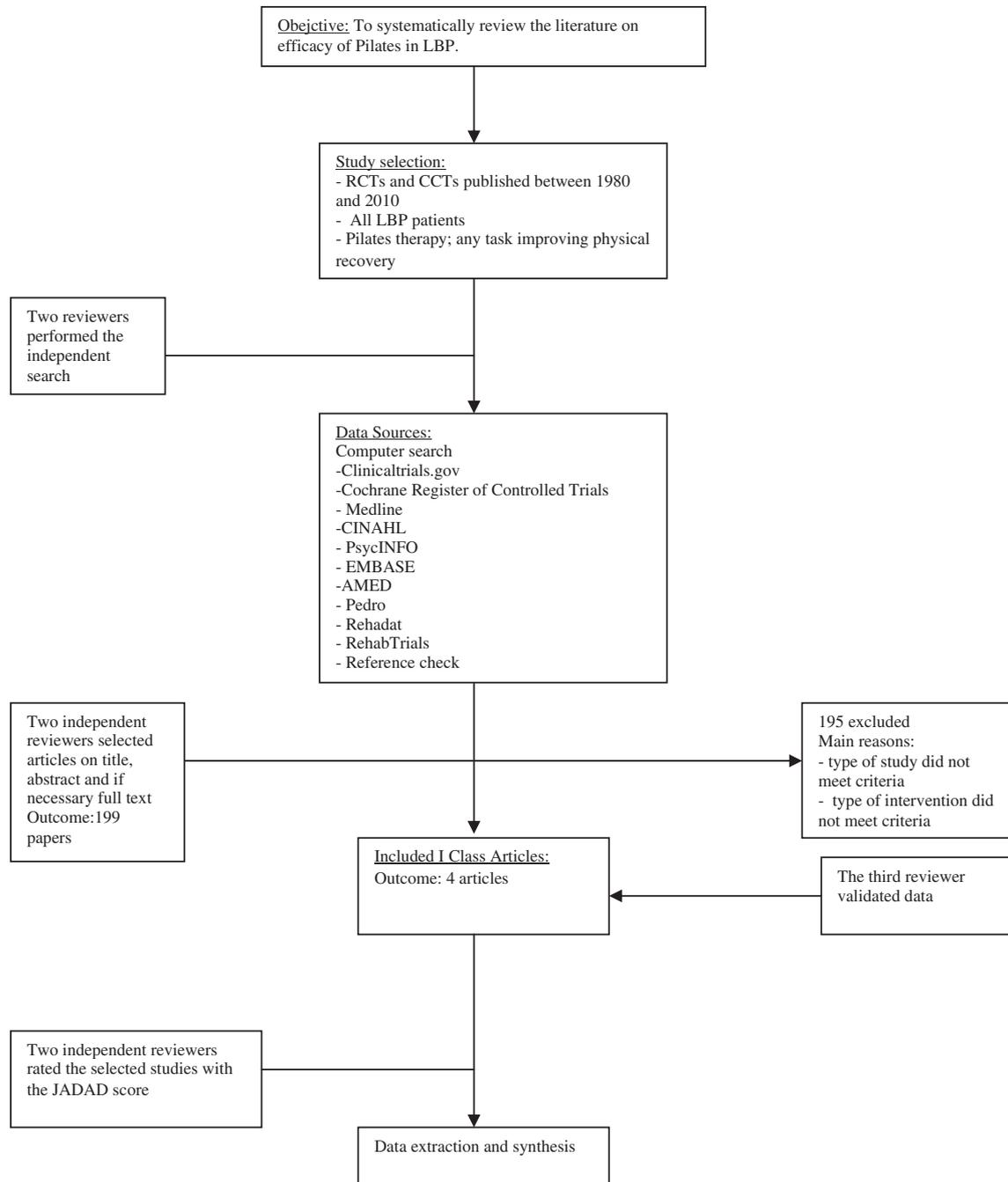


Fig. 1. Flow chart diagram.

This is a relatively well-designed trial with the randomization clearly specified. The inclusion and exclusion criteria were predetermined and the group was homogeneous. The loss to follow-up ratio is adequately established. Reasonably strong statistical procedures were used and intention to treat analyses was conducted. However, this study is partially blinded as only the physiotherapists were blinded to the results of testing and the relatively low response rate of 57% at 6 months may confound the strength of the findings. We gave this study a score of 4.

Vad et al.²⁷ conducted a prospective randomized study on 87 patients with discogenic LBP to determine the efficacy of the Back Rx programme, which comprises elements of physical therapy, rehabilitation, yoga and Pilates. The treatment group also received drugs, namely celecoxib and hydrocodone with acetaminophen as needed,

and wore a lumbar cryobrace for 15 min before going to bed at night while the control group received drugs and a lumbar cryobrace only. Outcome measures included RMDQ, numeric pain rating score, patient satisfaction score, measured forward flexion, use of drugs, time off work and rate of symptom recurrence. The authors report that at the 12-month follow-up 70% of the therapeutic group reported over 50% pain reduction and good or better patient satisfaction compared to 33% in the controls ($P = .001$). We gave this study a score of 2 for several reasons. Firstly, it lacks explicit description of the randomization process. The statistics used are mainly descriptive. No intention to treat analysis was performed, nor are dropouts sufficiently described. The study also lacks blinding procedures: neither therapists nor assessors were blinded to the intervention and analysis respectively. Although the authors define a successful outcome as

Table 1
Summary of clinical trials of Pilates for Low Back Pain.

Study	Results	Jadad score	Sample	Intervention	Controls	Outcome measures
Donzelli et al., 2006	A significant reduction in pain intensity and disability and better compliance and response to treatment	1	n = 53	Pilates	Back School Intervention	Oswestry Low Back Pain Disability Questionnaire (OSWDQ) Visual Analogue Scale (VAS) and subjective
Gladwell et al., 2006	Increases ($P < .05$) in general health, sports functioning, flexibility, proprioception, and a decrease in pain	3	n = 49	Pilates	Normal activities	OSWDQ, VAS, SF-12, Stork stand test, Sit-and-reach test
Rydeard et al., 2006	Significantly lower level of functional disability and pain intensity	4	n = 39	Pilates	Usual care	Roland-Morris Disability Questionnaire (RMDQ), NRS-101
Vad et al., 2007	50% reduction in pain among 70% of the treatment group ($P = .001$)	2	n = 87	Back Rx Program + drugs	Drug therapy and cryobrace	RMDQ, Numeric pain rating score (NRS) Patient satisfaction score Forward flexion test Use of drugs Time off work Symptom recurrence

'greater than 50% pain reduction with good or better patient satisfaction', there is no reference for this claim. The study does have some methodological strengths such as clearly specified inclusion and exclusion criteria that may compensate for possible biases.

Generally, the populations of patients with chronic non-specific LBP were well defined.^{24–26} Only Vad et al.²⁷ define patients as 'discogenic with LBP'. Similarly, homogeneous outcome measures were applied. For instance, all the studies measured pain and functional disability, two using RMDQ^{26,27} and two using OSWDQ.^{25,24} Additional measurements across the studies included the use of drugs, symptom recurrence, time off work²⁷ and quality of life and physiological indicators such as the Stork test and the Sit-and-Reach test, both for physical fitness, in Gladwell et al.'s trial.²⁵ On the other hand, several inconsistencies were noticed. First of all, with respect to intervention there is no uniform physical/functional assessment nor eligibility criteria at the baseline of all the studies. For example, to assess and confirm the existence of LBP, patients in the Vad et al. study²⁷ should have documented evidence of disk pathology (e.g. protrusion) as indicated by magnetic resonance imaging. Rydeard et al.²⁶ measured the relative strength of the *gluteus maximus* muscle using the Lovett test and by visual observation to confirm the presence of LBP. Donzelli et al.²⁴ established inclusion criteria for patients with a negative Laseque sign for a straight leg raise, and Wasserman tests. Interestingly, Gladwell and colleagues looked at the use of drugs and pain in the lower back at the baseline.²⁵ Similar discrepancies were observed in terms of the intervention itself: Gladwell et al.²⁵ describe modified Pilates; Vad et al.²⁷ the Back Rx program (which includes Pilates), Donzelli, Pilates Cova Tech²⁴ and Rydeard et al. mention specialized Pilates exercise equipment manufactured by Pilates Reformer, Balance Body Sacramento CA.²⁶

5. Discussion

This review explores the clinical effectiveness of Pilates in LBP patients. Very few studies have been identified that investigate the effectiveness of the Pilates method for the treatment of LBP patients. There was one good study (Rydeard et al., 2006)²⁶ in which the risk of bias was relatively low. Reasonably high homogeneity is observed across all studies in terms of outcome measures. All the reviewed papers focus on functional disability and pain. Nevertheless, this review indicates that there is heterogeneity at various levels including methodology, physical examination, population, the intervention itself and the outcome measures. For instance, the duration of the interventions ranged from six weeks (Gladwell et al. study²⁵) to twelve months (Vad et al.²⁷). Despite the fact that Rydeard et al.²⁶ conducted the highest-quality clinical trial of those included in this review, the subjectivity inherent in measuring the strength of the *gluteus*

maximus muscle using the Lovett test and by visual observation of this muscle maximizes the risk of bias in recruitment to the study. There is considerable inconsistency across the studies regarding assessment of LBP at the baseline, with Donzelli et al.²⁴ using the Laseque test, which is known for its limited diagnostic accuracy and low specificity.²⁸ This may have resulted in an increased number of false positives in recruitment to their study. Ideally there should be one standardized assessment to determine inclusion and exclusion criteria in future research. Van der Windt et al. suggest that a combination of SLR and imaging can increase specificity and sensitivity in LBP diagnosis in primary health care settings.²⁹ There is wide variation in terms of the onset and duration of LBP in the samples. Gladwell et al.²⁵ consider chronic LBP patients to be those who have had symptoms for more than twelve weeks; Donzelli et al.,²⁴ three months; Rydeard et al.,²⁶ six weeks and Vad et al.,²⁷ 'at least three months. The authors also include vague and undefined categories such as 'regular physical activity' (Gladwell et al.)²⁵ and 'sufficient intensity to restrict functional activity in some manner' when recruiting LBP patients (Rydeard et al.)²⁶ There is little homogeneity in terms of control group intervention, varying between 'routine' or 'standard intervention' (Rydeard et al.)²⁶; the Back School Program (Donzelli et al.)²⁴; no intervention (Gladwell et al.)²⁵ and drug therapy (Vad et al.)²⁷ Clearer definitions of 'usual' or 'standard' care are needed. Rydeard et al. define usual care as 'consultation with a physician and other specialists and health care professionals as necessary',²⁶ but standard care may also include analgesics,³⁰ leaflets,³¹ or electrotherapy and general exercise.³² It is important to emphasize that standard care for LBP patients needs to be redefined if included in future research.

Overall, all four studies lack formal power and sample size calculation and employed relatively small samples and therefore all lack generalizability, meaning that results cannot be extrapolated to the wider LBP population. Furthermore, the limited sample sizes in these trials did not allow us to perform a meta-analysis.

The potential limitation of this review is that the authors did not include such key words as pelvic floor, core stability, core strength, transversus abdominis and multifidius in their search strategy, since strengthening core stability and the above-mentioned muscles is one of the purposes of the Pilates method. However, if the authors had included these key words this approach could be criticized for limiting the Pilates method to strengthening the pelvic floor muscles only. Also, from the methodological standpoint comparing and contrasting Pilates as an intervention with trials that focus on core stability *per se* only was not feasible, as Pilates focuses on a more global approach including coordination, endurance, flexibility, cognitive processes and self-awareness. Some researchers have written that the important elements of improving back pain, including biological, educational,

and psychological aspects, are encompassed within the principles of Pilates training and that therefore this method should be regarded as a theoretically and practically coherent.³³

6. Conclusions

Although some of the authors of the reviewed studies conclude that Pilates yielded better therapeutic results than usual or standard care,^{25–27} the findings of this review suggest that the evidence available for its clinical effectiveness is inconclusive. This systematic review shows that the evidence base for Pilates method remains scarce and therefore larger and better-designed clinical trials are needed.

References

- Egle UT, Nickel R. Chronic low back pain as a somatoform pain disorder. *Orthopaed* 2008 Apr;**37**(4):280–4.
- Furlan AD, Imamura M, Dryden T, Irvin E. Massage for low-back pain. *Cochrane Database Syst Rev* 2008 Oct 8;(4):CD001929.
- Don AS, Carragee E. A brief overview of evidence-informed management of chronic low back pain with surgery. *Spine J* 2008 Jan-Feb;**8**(1):258–65.
- Donelson R. Is your client's back pain 'rapidly reversible'? improving low back care at its foundation. *Prof Case Manag* 2008 Mar-Apr;**13**(2):87–96.
- Pradhan BB. Evidence-informed management of chronic low back pain with watchful waiting. *Spine J* 2008 Jan-Feb;**8**(1):253–7.
- Malanga G, Wolff E. Evidence-informed management of chronic low back pain with trigger point injections. *Spine J* 2008 Jan-Feb;**8**(1):243–52.
- Seidler A, Liebers F, Latza U. Prevention of low back pain at work. *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz* 2008 Mar;**51**(3):322–33.
- Hammill RR, Beazell JR, Hart JM. Neuromuscular consequences of low back pain and core dysfunction. *Clin Sports Med* 2008 Jul;**27**(3):449–62.
- Hebert J, Koppenhaver S, Fritz J, Parent E. Clinical prediction for success of interventions for managing low back pain. *Clin Sports Med* 2008 Jul;**27**(3):463–79.
- Little P, Lewith G, Webley F, Evans M, Beattie A, Middleton K, et al. Randomised controlled trial of Alexander technique lessons, exercise, and massage (ATEAM) for chronic and recurrent back pain. *BMJ*; 2008:337. a884.
- Cairns MC, Foster NE, Wright C. Randomized controlled trial of specific spinal stabilization exercises and conventional physiotherapy for recurrent low back pain. *Spine (Phila Pa 1976)* 2006 Sep 1;**31**(19):E670–81.
- Hodges PW, Richardson CA. Inefficient muscular stabilization of the lumbar spine associated with low back pain. A motor control evaluation of transverses abdominis. *Spine* 1996;**21**(Suppl. 22):2640–50.
- Hides JA, Jull GA, Richardson CA. Long-term effects of specific stabilizing exercises for first-episode low back pain. *Spine* 2001 Jun 1;**26**(11):E243–8.
- Culligan PJ, Scherer J, Dyer K, Priestley JL, Guingon-White G, Delvecchio D, et al. A randomized clinical trial comparing pelvic floor muscle training to a Pilates exercise program for improving pelvic muscle strength. *Int Urogynecol J Pelvic Floor Dysfunct* 2010 Apr;**21**(4):401–8 [Epub 2010 Jan 22].
- Latey P. Updating the principles of the Pilates method. *J Bodyw Mov Ther* 2002;**6**(2002):94–101.
- Sekendiz B, Altun O, Korkusuz F, Akın S. Effects of Pilates exercise on trunk strength, endurance and flexibility in sedentary adult females. *J Bodyw Mov Ther*; 2007; Nov;(4):318–26.
- Latey P. 2001. The Pilates method: history and philosophy. *J Bodyw Mov Ther*; 2001; May (4):275–82.
- Altan L, Korkmaz N, Bingol U, Gunay B. Effect of pilates training on people with fibromyalgia syndrome: a pilot study. *Arch Phys Med Rehabil* 2009 Dec;**90**(12):1983–8.
- Jadad AR, Moore RA, Carroll D, Jenkinson C, Reynolds DJM, Gavaghan GJ, et al. Assessing the quality of reports of randomized clinical trial: is blinding necessary? *Control Clin Trials* 1996;**17**:1–12.
- Clark O, Castro AA, Filho JV, Djubelgovic B. Interrater agreement of Jadad's scale. *Cochrane* 2001;**1**:op031.
- Kloubec JA. Pilates for improvement of muscle endurance, flexibility, balance, and posture. *J Strength Cond Res* 2010 Mar;**24**(3):661–7.
- Merrithew M. Pilates for pain management. *Rehab Manag* 2009 Mar;**22**(2) (24):26–7.
- da Fonseca JL, Magini M, de Freitas TH. Laboratory gait analysis in patients with low back pain before and after a pilates intervention. *J Sport Rehabil* 2009 May;**18**(2):269–82.
- Donzelli S, Di Domenica E, Cova AM, Galletti R, Giunta N. Two different techniques in the rehabilitation treatment of low back pain: a randomized controlled trial. *Eura Medicophys* 2006 Sep;**42**(3):205–10.
- Gladwell V, Head S, Haggart M, Beneke R. Does a program of pilates improve chronic non-Specific low back pain? *J Sport Rehabil* 2006;**15**:338–50.
- Rydeard R, Leger A, Smith D. Pilates-based therapeutic exercise: effect on subjects with nonspecific chronic low back pain and functional disability: a randomized controlled trial. *J Orthop Sports Phys Ther* 2006 Jul;**36**(7):472–84.
- Vad VB, Bhat AL, Tarabichi Y. The role of the Back Rx exercise program in diskogenic low back pain: a prospective randomized trial. *Arch Phys Med Rehabil* 2007 May;**88**(5):577–82.
- Devillé WL, van der Windt DA, Dzaferagić A, Bezemer PD, Bouter LM. The test of Lasègue: systematic review of the accuracy in diagnosing herniated discs. *Spine* 2000 May 1;**25**(9):1140–7.
- van der Windt DA, Simons E, Riphagen II, Ammendolia C, Verhagen AP, Laslett M, et al. Physical examination for lumbar radiculopathy due to disc herniation in patients with low-back pain. *Cochrane Database Syst Rev* 2010 Feb 17;**2**:CD007431.
- Koumantakis GA, Watson PJ, Oldham JA. Trunk muscle stabilization training plus general exercise versus general exercise only: randomized controlled trial of patients with recurrent low back pain. *Phys Ther* 2005 Mar;**85**(3):209–25.
- Norris C, Matthews M. The role of an integrated back stability program in patients with chronic low back pain. *Complement Ther Clin Pract* 2008 Nov;**14** (4):255–63 [Epub 2008 Jul 26].
- Mohseni-Bandpei MA, Rahmani N, Behtash H, Karimloo M. The effect of pelvic floor muscle exercise on women with chronic non-specific low back pain. *J Bodyw Mov Ther*, in press, doi:10.1016/j.jbmt.2009.12.001.
- Simmonds MJ, Dreisinger TE. Lower back pain syndrome. In: Durstine JL, Moore GE, editors. *ACSM's exercise management for Persons with chronic Diseases and Disabilities*. 2nd ed. Champaign, Ill: Human Kinetics; 2003. p. 217–21.