

Review Article

The Effectiveness of Mat Based Pilates Exercise in Chronic Non-Specific Low Back Pain: A Systemic Review

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ABSTRACT

Objective: To systematically review and analyse all randomized control trials done on mat based Pilates exercises.

Study design: Systemic review

Methods: Articles were searched electronically from science direct, MEDLINE, EMBASE, PEDro, CINAHL, and SPORT Discus published in English. Research studies published since inception to Jan 2014 were selected for review. Two reviewers applied inclusion criteria to select potential studies. The methodological quality of the study was evaluated using two instruments, namely PEDro and Jadad scales.

Results: Four eligible randomized controlled trials (n=5) were selected with PEDro score varying from 3-7 and 2-4 on Jadad scale.

Conclusion: Although there is some positive 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 for giving larger representation and more reliable results.

Key words: Pilates Based Exercises, Low back pain, Systemic review, Exercises.

INTRODUCTION

Low back pain [LBP] is one of important health problems affecting not only workers but also the general population. Back pain has become one of the most common problems in industrialized societies; it can affect 80% of the people and has become the most common cause of functional limitation in individuals younger than 45 years. ^[1] By definition, low back pain is pain in the area between the inferior most aspects of the scapula and gluteal folds, with or without radiation to the lower extremities. ^[2] Chronic non-specific low back pain [CLBP] is defined as pain located in the lower region of the spine (below the

ribs and above the legs) due to an unknown cause. This condition can be mentioned as acute (< 3 months), chronic (> 3 months), or recurrent. ^[3]

A wide variety of therapeutic interventions are available for the treatment of chronic low back pain, ranging from general physical fitness or aerobic exercise to muscle strengthening, various types of flexibility and stretching exercises. ^[4] The effective therapeutic exercise for the management of CLBP is still debated in systematic reviews and in the adoption of therapy recommendations, ^[5,6] published a review on the effectiveness of exercise therapy for LBP, he advised exercises may

be helpful for CLBP patients to increase return to normal daily activities and work. The conclusions of this study indicate no evidence to support the effectiveness of exercise for acute LBP, but may be helpful for CLBP.

General conditioning programs to improve the strength and endurance of spinal musculature have been shown to reduce pain intensity ($P=0.002$) and disability ($P=0.023$), therefore the programs seem to be advantageous in the treatment of non-specific chronic low back pain. [7,8] Among them, the Pilates method is one increasingly common exercise regimen suggested for patients with low back pain.

Based on methods developed by Joseph Pilates (1880-1967), this program consists of movement routines, facilitated by the use of special equipment, that are designed to enhance flexibility, strength and coordination. [9] Certain traditional Pilates principles followed during the exercise, they are Centering, Concentration, Control, Precision, Flow and Breathing. [10] Pilates based exercise has been updated in recent years and has implemented in the physical therapy community in recent years to improve rehabilitation programmes. [1,8,11-13] These Pilates exercises can be performed with specific apparatus called as equipment based Pilates exercises [7,14,15] or without using them by simple mat to perform the exercise called as Mat-based Pilates exercise [MPE]. The MPE are not as demanding in the terms of supervision and easily affordable and readily available and it can be taught in larger groups compared with apparatus exercise. [13]

The MPE was designed with the intent to improve posture and control of movement via Neuro muscular techniques believed to improve lumbar spine stability through targeting the local stabilizer muscles of the core muscles. [7] Pilates exercises activate and strengthen deep abdominal muscles [16] as well as “core muscles” which are involved in dynamic stability of the spine [17] by decreasing erosion and stress on the joints of lumbar

spine. [18] Whereas, Transversus abdominis activation increased following a program of unsupervised MPE that is practical and requires no special equipment, but there was no change in abdominal muscle activation during functional postures. [19]

Previous systemic reviews on the effectiveness of Pilates based exercises were done generally on Pilates exercises [20] i.e. equipment based Pilates alone or along with the mat based Pilates, but not exclusively on MPE. MPE will be most applicable in dealing with clinical cases of CLBP in physiotherapy clinics without having access to the Pilates reformer or the other equipment's. Whereas few studies were done on mat based Pilates or modified Pilates like Pilates Cova Tech [11] for treating CLBP. This issue reinforces the need for more specific systemic review on the effectiveness of MPE for CLBP. The aim of this systematic review is to identify peer-reviewed, published literature that describes MPE exercise will be effective in treating CLBP.

MATERIALS AND METHODS

Search strategy

Articles were searched using the following database (from 1995 - 15 Jan'2016): Science direct, MEDLINE, EMBASE, Physiotherapy evidence database (PEDro), cumulative index to nursing and allied health literature (CINAHL), Cochrane Library, Pub Med and SPORT Discus. The standardized search strategy included the use of Medical Subject Headings (MeSH) terms. The MeSH terms used for the search were “Pilates”, “LBP”, “Mat based Pilates”, “Low back pain”, “Randomized controlled trial” and “Exercise Therapy”. These steps were repeated for other databases. An example of full electronic search strategy for MEDLINE is provided in Table 1. Totally 12 potential studies were found and the first information analysis were done by two independent reviewers. A first selection was performed by means of study title, abstract and key words. A second selection was made in depth by

predefined inclusion criteria. After secondary evaluation, reviewers finalized 5 potential papers for the review. The final day of the search was performed on 20 Jan'2016.

Study Selection

Eligibility assessment of the manuscript was performed by two reviewers. Disagreements between the reviewers were resolved by consensus. Initially checklist was prepared for the inclusion criteria.

Criteria for inclusion

To select studies to be reviewed, the following inclusion criteria were used:

- a) Randomized controlled trials (RCTs)
- b) Studies carried out on adults with CLBP,
- c) Abstracts related to MPE
- d) Studies where CLBP treatment was based on mat Pilates Method,
- e) Studies published in scientific journals between 1995 and Jan 2016,
- f) Studies published in English.

Method of quality assessment:

The methodological quality of the study was evaluated using two instruments:

1. PEDro
2. Jadad scales

The PEDro scale [Table 2] was based on the Delphi list which has 11 items to evaluate the four fundamental

methodological aspects of the study. [21] PEDro scale scores range from 1 to 10; higher PEDro scores correspond to higher method quality. The eligibility criterion is related to external validity and is not used to calculate the PEDro score. PEDro score of less than 5 indicates low quality and PEDro score of 5 or higher indicates high quality.

The reliability of this scale was reliable and acceptable results were obtained by intra-class correlation coefficients (ICC) = 0.56 (95% CI=0.47-0.65) for rating the individuals, and for consensus ratings = 0.68 (95% CI =0.57 - 0.76). Many studies [20,22-24] have used this scale to evaluate more than 3000 articles which were indexed on PEDro database. The Jadad scale [25] is most commonly used scales for evaluating the clinical tests. The clinical test quality will be evaluated by means of five items [Table 3]. The inter-examiner reliability of jaded scale was well demonstrated by several articles. [26,27]

Table 1: Step Search (Limits applied: "Humans" and "English")

1.	"Pilates" (MeSH) or "Mat Pilates"(MeSH)
2.	"LBP "(MeSH)
3.	"Low back pain"(MeSH)
4.	"Randomized Controlled Trials" (Mesh) or "Randomized Controlled Trial" (PT)
5.	"Exercise Therapy"(MeSH)
6.	"Back pain"
7.	1 or 2 or 3 or 4 or 5

MeSH, Medical subject heading; PT, Publication type.

Table 2: PEDro scale [20]

1	Eligibility criteria were specified	Yes	No
2	Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received)	Yes	No
3	Allocation was concealed	Yes	No
4	The groups were similar at baseline regarding the most important prognostic indicators	Yes	No
5	There was blinding of all subjects	Yes	No
6	There was blinding of all therapists who administered the therapy	Yes	No
7	There was blinding of all assessors who measured at least one key outcome	Yes	No
8	Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups	Yes	No
9	All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analysed by "intention to treat"	Yes	No
10	The results of between group statistical comparisons are reported for at least one key outcome	Yes	No
11	The study provides both point measures and measures of variability for at least one key outcome	Yes	No

Table 3: Jadad scale [25]

1	Does the study randomized?
2	Does the study double blinded?
3	Does the study describe if subjects withdraw?
4	Does the randomization adequately described?
5	Does the blindness adequately described?

RESULTS

Study selection

On searching the database, 5 RCTs [1,8,11-13] were eligible for systemic review. Both the independent reviewers had 100% agreement about the selection of papers. Most of the papers were excluded because they used MPE exercises along with

equipment Pilates or other exercises in the experimental group.

Methodological quality

The internal validity of the PEDro scale was only assessed. PEDro scale scored from 4-8 (mean- 6.4). Among these only three studies of Gladwell et al., [1] Miyamoto et al., [12] and da Luz et al., [13] scored above 5 points whereas study by dafonesca et al., [8] scored 5 points. Only one study by Miyamoto et al., [12] 4 points.[Table 5]. Descriptions of the treatments of the included trials are outlined in Table 4. Jadad scale score from 1-4, with a mean average of 2.6 [Table 6]

Table 4: Details of the RCTs included for the review

Study	Method	Subjects	Intervention	outcome
Gladwell et al., [1]	RCT Blinding assessors	N=49 Age: EG - avg36; CG avg: 45 Total Average: 40	EG: Pilates on mat CG: Without specific intervention and with medication. Duration: 1 session in clinic week for 6 weeks.2 session in home for 6 weeks.	Results shows improved general health, activity, flexibility, and proprioception and diminished pain.
Donzelli et al., [11]	RCT Blinding assessors	N = 53 Age:50(Average)	CG: Back School method EG: Mat Pilates Duration: 1h sessions for 10consecutive days	Significant decrease in pain and disability but both groups were not compared.
Miyamoto et al., [12]	RCT Blinding assessors	N= 86 Age: EG average: 40.7; CG average:38.3,	CG : Pilates Education EG: Modified Pilates Exercise & Education Duration : CG: 6 Weeks Follow Up EG: 1h twice a week for 6 weeks.	EG showed small to moderate short term reduction in pain, disability and global impression of recovery in CG. However these improvements were not sustained after 6 months.
da Luz et al. [13]	RCT Blinding assessors	N=86 Age average: Mat group: 43.5 Equipment Pilates group :38.8	EG:Mat Pilates (n=43) and equipment pilates (n=43). The patients of both groups attended 12 Pilates sessions for 6 weeks period.	Equipment Pilates was superior to mat Pilates in the 6 months follow-up for disability and kinesiphobia, but not observed for pain & global perceived effect.
dafonesca et al., [8]	RCT Single blinded	N= 28 Avg.Age: CG:25.36, LBG: 33.12 Duration of LBP : >6m	CG: no treatment, normal activity, medication. EG:matpilates programme Duration PG: 15 session,2 sessions /week for 60min.	Pilates group showed increase in walking speed with reduced pain and improving weight discharge during gait.

Abbreviations: CG:Control Group, EG: Experimental Group, PG:Pilates Group, LBG: Low Back Group.

Table 5: PEDro scale score for the RCT's in the review

Author	1	2	3	4	5	6	7	8	9	10	11	Sum
Gladwell et al., [1]	1	1	1	1	0	0	1	0	0	1	1	7/11
Donzelli et al., [11]	1	0	0	1	0	0	1	0	0	0	1	4/11
Miyamoto et al., [12]	1	1	1	1	0	0	1	1	0	1	1	8/11
da Luz et al. [13]	1	1	0	1	0	0	1	1	1	1	1	8/11
dafonesca et al., [8]	1	0	0	0	1	0	1	0	0	1	1	5/11

Table 6: Jadad scale score for the randomised controlled trials in the review

Author	1	2	3	4	5	Sum
Gladwell et al., [1]	1	0	0	1	1	3/5
Donzelli et al., [11]	1	0	0	0	1	2/5
Miyamoto et al., [12]	1	0	0	1	1	3/5
da Luz et al. [13]	1	0	1	1	1	4/5
dafonesca et al., [8]	1	0	0	0	0	1/5

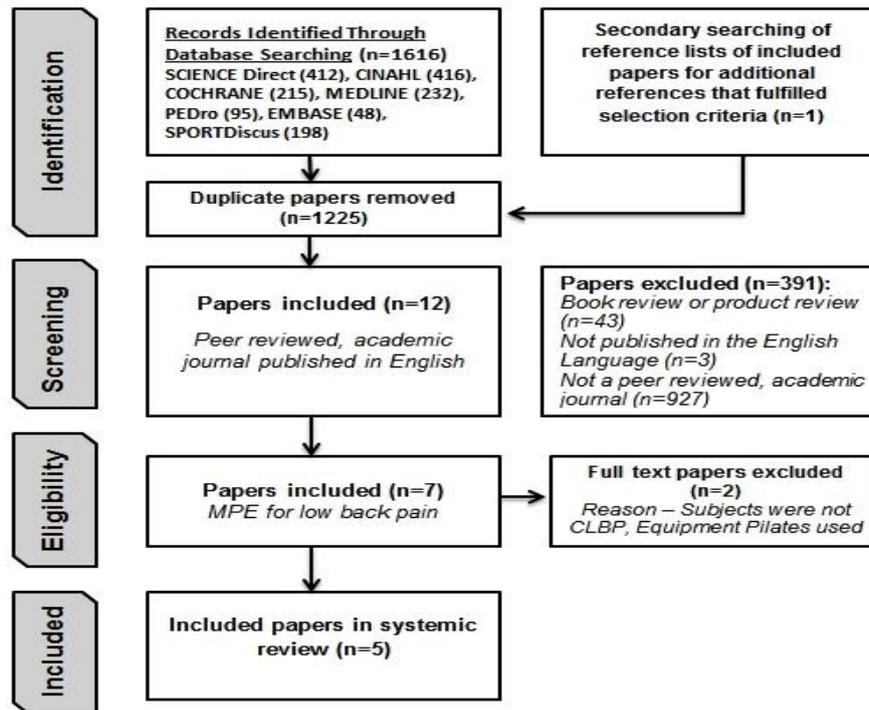


FIGURE 1: Study flowchart.

Study characteristics

Gladwell et al., [1] compared experimental group (n=20) with control group (n=14). The exercises were done at the clinic and also at home without supervision. The controls continued with their regular duties and analgesics. The results show decrease in pain and no improvements in function. This study made an adequate between group comparison and acceptable statistical analysis. The only discrepancy is that less than 85% of the subjects completed their study, so the dropout rate was high in studies of Gladwell et al., [1] while compared to other study groups.

Donzelli et al., [11] obtained the lowest score and this was due to several inconsonant in the explanation of the descriptions when referring to research model. For example, in “Methods” section, it does not mention how it was randomized, or if it was performed according to convenience of author. Another discrepancy of this study is that it does not perform within group analysis and the results were given in descriptive way. The dropout rate

was described and it was acceptable in this study.

da Luz et al. [13] has compared MPE to the equipment based Pilates exercise. In the within-group comparison, the results showed a significant difference for all outcomes (p<0.01) except kinesiophobia in the MPE group at 6-month follow-up. In the between-group comparison with equipment Pilates group, the results showed no significant difference for any of the outcomes in the 6-week follow-up. In the 6-month follow-up, there was a significant difference with greater improvement in the equipment-based group for the outcomes of disability and kinesiophobia scores. However, Miyamoto et al. [12] and da Luz et al. [13] studies were the most identical in terms of study layout [Tables 4 and 5]. But both of these studies were statistically significant, but Miyamoto et al., [12] does not explain about the subject withdrawal and patience adherence.

Dafonesca et al., [8] included multiple outcomes in the study, there were significant improvements in weight discharge in gait and decreased intensity of CLBP. This study dint measure medium

term effects of treatment (assessment after 6 months). The controls used in this study were normal subjects whose average age was 25 compared to the LBP group, with average age of 33.

In general, all the study design used pre-post-test (n=5), and all the patients treated were having CLBP for more than 12 weeks. Four studies [1,8,12,13] were using secondary outcome measure during the study intervention. All the studies (n=5) were conducted with both sexes and used MPE as a study intervention. Only two studies [12,1] described about the follow up of the study after 6 months. PEDro scale items satisfied in 4 RCT related to similarity of subject characteristics at baseline, between group comparisons. Furthermore, sample sizes were small in three groups. [1,8,11] ranging from 28-53 when compared to 86 samples by two authors. [12,13] In Gladwell et al., [1] and da Fonseca et al., [8] controls were without specific intervention, whereas in Miyamoto et al., [12] controls treated with very minimal intervention. Another two studies by Donzelli et al., [11] and da Luz et al., [13] received contradictory interventions such as equipment based Pilates and back school method. The duration and frequency of MPE programme ranges from 10 days to 6 weeks. Three studies conducted >6 weeks with each class will last for 1 or 2 hours per week, whereas Donzelli et al., [11] conducted only 10 consecutive sessions of Pilates with 60 min duration.

DISCUSSION

This article reviews the available evidence for mat based Pilates exercise is effective in treating the subject with CLBP. All the RCTs have different conclusions, despite having analogous research objectives. The clinical heterogeneity of studies indicates the meta-analysis was inappropriate, because pooling of heterogeneous studies can produce inaccurate study results. Due to significant results from the above studies, we found moderate evidence to support the use of mat based Pilates exercises for decreasing pain,

improving disability and function. There was limited evidence to support the increase in range of motion along with muscle strength of transverse abdominis and back muscles but sufficient evidence were present to support decrease in pain intensity and disability. The methodological qualities of all the 4 studies were acceptable in terms of effectiveness for MPE; all the studies show the positive results by reducing pain and improving function.

Few studies have [1,12,8] appropriately compared to their corresponding control groups. Hence the results are most impressive in terms of the effectiveness for MPE on reduction in pain. However, in both the studies, control and Pilates group were encouraged to make no changes to exercise, medications, activities and analgesics. Therefore, the contribution of pain relief may be obtained by other means such as exercise or medications. Whereas, Gladwell et al., [1] da Luz et al., [13] and da Fonseca et al., [8] have adapted the basic principles of Pilates exercise and involved certified physical therapists for supervision of treatment.

In Donzelli et al., [11] study considered quasi-random, when PEDro was assessed it scored only 3 points: groups similar at baseline, blinded assessor, point measures and variability. This study apparently shows firm results, but the trouble is that they are exhibited in a descriptive way and this makes the interpretation of these results little complex, and also difficult to reach a conclusion of this study. In study by da Fonseca et al., [8] the randomized allocation and blinding has not been explained along with the subject's with drawl and follows up. The control groups were of normal subjects and they were compared with the CLBP patients with and without Pilates intervention, but the sample size is limited (n=17), which may be inadequate to obtain a statistical satisfaction of results.

Miyamoto et al., [12] compared Pilates with minimal intervention, whereas Pilates group had shown positive results in

patient specific disability and kinesiophobia, but these improvements did not sustain more than 6 months. The complexity of the exercises can be improved by incorporating dynamic movements. According to da Luz et al., [13] the results show that equipment based Pilates are more effective compared to mat based Pilates, however, mat based exercise has also shown a positive result on within group analysis, by decreasing in pain and disability at 6 weeks follow up. So it shows the results of disability and kinesiophobia sustain for longer periods of time in equipment Pilates alone, for medium term effect. Furthermore, they haven't used tight control groups, by which we cannot obtain the reliable results of the study. In this study subjects continued their daily medications and activities, so which may influence the scoring, whereas during the follow up period the subjects home programme or other treatment undertaken were not clearly mentioned. This study shows high adherence to treatment as well a low drop-out rate because the intention to treat criterion was satisfied only in this study.

Furthermore, it should be considered that there were only few papers that focused on MPE alone in relation to equipment based exercises. This review has also highlighted that, use of MPE in all studies have an efficient decrease in pain and disability scores with a significant difference. All studies encouraged patients to perform home exercise during the study, but there is no evidence to determine whether subjects performed their home exercises, besides subjects log book evidence. So it is difficult to determine the maximum interventional effect that could have been achieved to reduce LBP.

CONCLUSION

To our knowledge, this is the first systemic review to find the effectiveness of mat based Pilates in CLBP. Thus the advantage of MPE is readily less expensive, doesn't need any equipment's and can treat up to 6-8 subjects at a single session. The

results of the systemic review analysis demonstrates the positive effects, such as improving general functions, reducing pain, disability and gait when applying the MPE in subjects with CLBP. Rather than using a temporary pain relief method, such as analgesics, MPE is an alternative method that focuses on strengthening core muscles, correct posture; relieve pain, disability and finally kinesiophobia upto some extent. One important point to be remembered is that the exercises prescribed in these studies were adapted to the patient's situation. It would also be important to identify and specify which modifications and adaptations are necessary for the mat based Pilates exercises to be used in various rehabilitation programs.

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