INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 25, No. 4, p. 47-60, 2024
http://www.innspub.net

REVIEW PAPER OPEN ACCESS

Harnessing pilates for postmenopausal Women: A holistic approach to managing low back pain and improving functional mobility, A systemic review

C. Nageswari[*1,2], N. Meena[1]

[1]*Department of Physical Medicine and Rehabilitation, Annamalai University, Government Cuddalore Medical College and Hospital (Erstwhile Rajah Muthiah Medical College and Hospital, India*

[2]*School of Allied Health Science, Galgotias University, Uttar Pradesh, India*

Article published on October 03, 2024

Key words: Postmenopausal women, Holistic approach, Back pain

Abstract

In India, where over 60% of the population has had severe back pain at some time in their life, the prevalence of low back pain is worrying. Women are more likely than males to experience low back discomfort, particularly postmenopausal women. This review discusses how pilates exercises can help postmenopausal women with their low back discomfort, posture, flexibility, strength, and balance. Articles published between 2008 and 2022 were found by searching the databases of PubMed, Web of Science, and Scopus. The selection and results of the studies were based on the following criteria: the studies had to assess how Pilates affected pain and flexibility in postmenopausal women with low back pain; these included systematic reviews, meta analyses, randomized controlled trials (RCTs), randomized clinical trials, randomized cross-over trials, quasi-RCTs, and non-RCTs. As outcome measures, the Oswestry disability scale, the Visual Analogue Scale (VAS), the Numeric Rating Scale (NRS), and the Quality of Life Scale were employed. The review study revealed that pilates exercise is a significant factor in low back discomfort in women who have gone through menopause, substantial improvements in balance and posture in 50 individuals following a 12-week period. In addition, sixty people with long-term low back pain who underwent Pilates demonstrated improvements in their overall health and vitality, their physical and social functioning, pain and impairment. The current review's findings suggest that pilates exercises are more beneficial than other treatments for lowering low back pain in postmenopausal women.

***Corresponding Author:** C. Nageswari ✉ nageswari@galgotiasuniversity.edu.in

Introduction

The Pilates technique is a form of low-impact exercise that may be modified to accommodate different medical and physical requirements. Van Tudler *et al.* (2004) reported that higher muscle tension is the cause of low back soreness. Low back discomfort lowers one's quality of life and is a major global public health concern (Hughes and Nancy, 2009). The effects of pilates exercises on patients experiencing non-specific low back pain in women who have gone through menopause have been the subject of several studies. According to Hayden *et al.* in 2005, there are a number of therapy approaches for the treatment of low back pain, including stretching and strengthening.

Pain prevents people from engaging in social interactions, household tasks, recreational activities, and self-care. In addition to housing, additional energy-intensive jobs include maintaining farms and taking care of animals. These activities are repetitious and hard, endangering the health of the animals. Disc degeneration is more common in postmenopausal women due to their relative estrogen shortage (Lee *et al.*, 2016). This research reviews the scientific literature on the effects of the Pilates technique on postmenopausal women's nonspecific low back pain. The purpose of this study is to describe and provide a thorough overview of the scientific literature contrasting the effects of Pilates exercise approaches on pain and range of motion in patients with postmenopausal women experiencing non- specific low back pain. The original research, meta-analyses, and systematic reviews of postmenopausal women with nonspecific low back pain that evaluated pain or flexibility are all included in this study. Research comparing the benefits of doing Pilate's exercises as the primary treatment to no treatment at all, as well as other forms of intervention exercises meant to enhance core stability and non-specific low back pain. There are eight studies including the Pilates exercise method in randomized cohorts, six trials comparing Pilates to no therapy, fifteen trials involving Pilates methods mixed with other forms of exercises, and eight reviews analysis the reviews.

Eligibility criteria

Comprehensive reviews of original research were taken into consideration for this review. These reviews involved adults with non-specific low back pain who were assessed for pain, disability, and therapeutic intervention of pilates method exercises taken as the main form of treatment compared with no treatment, with other types of interventions or exercises, and with various variations of the Pilates method alone.

Search approach and keywords

From 2007 to 2022, the aforementioned databases were used in the title, abstract, and keywords fields of the search strategy. The terms "pilates," "low back pain," and "post-menopausal women" were included in the title, abstract, and keyword as part of the typical search approach. Extending the search to include other terms like exercise, flexibility, strength, and core stability has shown to be beneficial, according to preliminary searches.

Information sources

Based on a review of the literature, publications spanning 2007 to 2022 were chosen. The databases listed below were examined: Pub med, DOAJ, Sci ELO, PLOS ONE, EBSCO, JSTOR, Web of Science, Google Scholar, Scopus Elsevier, Cochrane, DOAJ, MEDLINE-NLM, Science Direct and MEDLINE-EBSCO

Selection criteria

The featured publications were published in peer-reviewed English-language journals. The entire texts of the articles were reviewed to assess their acceptability for inclusion in comparison to the selection criteria, together with the title and abstract when needed. This narrative review might contain abstracts, opinion pieces, case reports, case series, systematic, randomised trials, and other types of materials.

Data extraction

The data that was extracted was as follows:

1. The writer and the year of release
2. Methodology layout

3. Measures of disability
4. Study samples
5. Interventions
6. Using a mat or other specific Pilates equipment
7. Primary outcomes

In order for the following points to be taken into account in this narrative review:
(1) Written in English and published.
(2) Complete publication so that the study's methodology and findings may be evaluated together.
(3) The Pilates method's efficacy was evaluated, with reference to the word "Pilates" designating the particular kind of recommended exercise under investigation.
(4) Participants with non-specific LBP, or localized pain in the lumbar area lasting longer than three months, were included. Studies were omitted if the individuals had LBP for less than three months.
(5) The VAS, numerical rating pain scale (NRPS), the Oswestry disability questionnaire, Roland-Morris disability questionnaire, Borg scale CR10, Quebec back pain disability scale, patient-specific functional scale, pain self-efficacy questionnaire, and randomized controlled trial with outcome measures for pain and/or functional ability that did not have sufficient validity, reliability, or responsiveness were excluded to avoid not appropriate measurements of treatment effect (Mother *et al.*, 2009). Used outcome measures with appropriate scales that evaluate pain and/or functional ability in people with LBP.

Comparison of the pilates method's pain-relieving effects with no intervention

Low back pain was measured in six trials (Natour *et al.*, 2015; Notarnicola *et al.*, 2014; Küçük and Livanelioglu, 2015; Rydeard *et al.*, 2006; Miyamoto *et al.*, 2012; Donzelli *et al.*, 2006) both before and after receiving no medicine or other kinds of intervention, including reading a book. The results were compared to those of the control group. Sixty patients with EG who were diagnosed with persistent low back pain continued to receive NSAIDs, Pilates, and CG without any further therapies. After 45, 90, and 180 days, assessments were carried out for function (Roland Morris Questionnaire), pain (VAS), satisfaction of life (SF-36), contentment with therapy (Likert scale), flexibility (sit and reach), and NSAID consumption.

A clinical investigation involving sixty individuals who had chronic LBP and a mean age of 51.2 years was carried out by Notornicola *et al.* in 2014. In this instance, the EG received Pilates while the CG remained inactive. The Pilates group performed five one-hour lessons of pilates exercises during the following six months. All respondents' questionnaires, including the Oswestry, SF-36, Roland-Morris disability, and Spinal Functional sort, were tested at baseline (T1) and six months later (T2). At T2, the Pilates group demonstrated gains in overall health and vitality, physical and social functioning, and pain and impairment. Küçük and Livanelioglu, 2015 included 66 women in total in their 2015 research. Three groups of subjects were formed: a control group (n = 20), a clinical pilates group (n = 21), and a verbal education group (n = 25). The analysis's findings showed that the CPG performed better than the VEG in terms of BMI, waist and hip circumference. In 2006, Rydeard *et al.* divided 39 physically active participants into two groups and followed them for three, six, and twelve months using chronic non-specific LBA. The control group just received medical advice, whereas the specialist exercise training group performed pilates exercises. After the therapy intervention period, the SETG exhibited substantially decreased levels of functional impairment. Over the course of a year, the participants in the SETG reported a substantial reduction in both LBP and disability. 53 individuals with non-specific low back pain for at least three months were included in either a pilates therapy or a back school treatment group in a research conducted by Donzelli *et al.* in 2006. Assessments were conducted before the onset of the research as well as one, six, and six months following the commencement of the intervention. VAS was used to assess pain, while OLBPDQ was used to assess disability and significant decrease in the severity of the pain and disability was perceived. Better compliance and a more subjective reaction to therapy

were demonstrated by the pilates technique group. In 2014, Lee *et al.* looked at 86 individuals who had persistent, non-specific LBP. An educational pamphlet regarding back discomfort was given to one group, and participants were then randomly assigned to either undergo 12 sessions of exercises based on pilates principles over a six-week period (n = 43) or not (i.e. education alone n = 43). At six months, the differences in pain were no longer statistically significant, favoring the pilates group.

Pilate's technique compared to alternative workout regimens for the result of pain

Both during and after these therapies, pain was evaluated, and the results were compared to CGs who engaged in other activities. Valerie *et al.* (2006) recruited 49 individuals with chronic low back pain, and they were randomized into two groups: CG (n = 24) and pilates (n = 25). The pilates group showed improvements in pain reduction, flexibility, sports functioning, and general health. Kao *et al.* (2014) used the polestar pilates technique to conduct a cross-sectional study to examine the effects of a 12-week Pilates program on the physical fitness of women living in the community. 53 people from the EG and 43 people from the CG were included. Women's muscular strength and trunk flexibility have been demonstrated to significantly increase with a convenient Pilates exercise regimen. According to June, who cites Kloubec *et al.* (2010), fifty people signed up for a 12-week pilates course that met for one or two hours per week. All variables showed substantial improvements after a 12-week period, with the exception of balance and posture.

Marshall *et al.* (2013) randomly assigned 64 individuals with low back discomfort to either a stationary cycling group (CEG) or a specialized trunk exercise group (SEG) for six-week duration. Data on disability catastrophizing, self-rated pain, and FAB scores were collected before the training session and eight weeks and six months later. The impairment of the SEG was significantly lower than that of the CEG after eight weeks. Both groups saw a decrease in discomfort from baseline after training, with the SEG experiencing a smaller drop. Eight weeks into the SEG and six months into the CEG, FAB scores started to decline. Martínez-Amata *et al.* (2015) evaluated the effects of pilates exercises on women over 65 with chronic low back pain's fear of falling and their ability to balance. A randomized controlled trial evaluating the benefits of six weeks of Pilates combined with physiotherapy treatment for 50 participants against 47 participants receiving only physiotherapy treatment for low back pain. When compared to the Physiotherapy group alone, the Pilates group showed improvement in functional mobility, balance and pain.

Campos de Oliveira *et al.* (2015) randomly assign 32 participants to the EG (n = 16) who participated in two weekly Pilates sessions for a duration of 12 weeks and the CG (n = 16) in two weekly sets of static stretching. The isokinetic torque of the knee extensors and flexors is measured by the TUG test, the Berg Balance Test, and the Health Survey assessment. The results showed that every category showed a considerable improvement for the EG. A research conducted by Ravindran *et al.* (2022) included 47 volunteers who had chronic low back pain that was non-specific. The NPRS and RM Questionnaire were used to measure changes. It has been discovered that for postmenopausal women experiencing non-specific chronic low back pain, pilates instruction is more effective in reducing pain and disability than aerobic exercise. Papapas *et al.* (2013) investigated the pain relief and functional improvement effects of a pilates exercise program utilizing the Fit ball on individuals with persistent low back pain. For six weeks, the 28 patients in the intervention group used the Fit ball to follow pilate's exercise regimen. When compared to no intervention, the results indicate that pilate's method can help persons with chronic low back pain feel less discomfort and function better. 74 patients with persistent non-specific low back pain, ages 65 to 85, were investigated by Oliveira *et al.* (2019) and divided into two groups: one for pilates (n = 37) and the other for aerobics (n = 37). Eight weeks following randomization, pain intensity and overall disability will be evaluated and showed the improvement in using pilates.

Forty senior women, 65 years of age or older, were split into two groups in a research by Hyun *et al.*, 2014: one group performed pilates mat exercises (PME), while the other group performed unstable support surface exercises (USSE). They worked out three times a week for forty minutes each for a total of twelve weeks. The PME and USSE groups showed a considerable improvement in the balance abilities of senior female persons, suggesting that pilates exercises are beneficial for improving balance in this specific set of subjects. 27 ambulatory older people who were community members were recruited by Bird *et al.* (2012) (n = 32). The participants were divided into two groups: one for group pilates instruction and the other for routine activities. After a six-week washout period, the participants carried out the alternative intervention. Despite substantial gains in both static and dynamic balance between the pre- and post-pilates periods, the assessed variables for the pilates and control groups did not vary significantly.

Chang and Lai (2013) looked at the relationship between HRV, the menopausal rating scale, and exercise activity in a cross-sectional research. The individuals were divided into three groups (low, medium, and high) according to how they exercised, which was determined by the findings of an ECG and a structured questionnaire. 327 postmenopausal females underwent assessment. Variations in exercise activity had an effect on the ANS adjustment and postmenopausal symptoms in women. Modifying exercise habits might potentially mitigate postmenopausal symptoms in women. Exercise helps mitigate the menopausal symptoms experienced by middle-aged women. Random assignment was used to place the postmenopausal women into three groups: control (17 women), pilates (17 women), and vibration (17 women).

Dual energy X-ray absorptiometry was used to evaluate the areal bone mineral density (BMD) at baseline and throughout follow-up. The inventions were implemented three times a week over six months, for a total of 78 sessions. After six months, 96% of the individuals completed the follow-up. The results revealed significant mean differences between the groups, indicating the effectiveness of the treatments.

The pilates method's impact on postmenopausal women's non-specific low back pain in randomized controlled trial

The application of pilates exercise to postmenopausal symptoms changed the symptoms significantly between groups and for the time interaction of physical, mental, and vasomotor symptoms, but not for the time. The use of pilates exercises to reduce urogenital symptoms revealed significant differences between the groups and an interaction, but no meaningful change was seen over time. Significant differences were seen in lumbar muscular strength changes between the groups following the administration of pilates exercise (Lee *et al.*, 2016) Changes in flexibility after applying pilates exercises to the sit and reach test showed significant differences between the groups. Similarly, significant differences were seen in time, interaction and group in the trunk lift test. In a (Cabral *et al.*, 2014) study, 86 people with chronic, nonspecific low back pain were examined. Patients were randomly assigned to one of two groups: mat pilates (n = 43) or equipment-based Pilates (n = 43). Both groups underwent 12 pilates lessons over the course of six weeks after randomization, and then again after six months. After six months, disability differenced statistically significantly.

A pilates exercise program was recommended by Gagnon in 2005 as a therapeutic intervention for low back pain. Twelve patients were split into two groups: six patients in EG (exercises) and six patients in CG (usual lumbar stabilization). The results were measured in terms of lumbar range of motion and measures using VAS and ODI AROM. All patients exhibited significant improvements in center balance time, pain and function. The study provides a sound and reliable basis for integrating pilates exercises as a therapeutic exercise intervention for people with lower back pain.

In a research conducted by Anand *et al.* (2014), 52 physically active people, ages 18 to 60, who had persistent, non-specific low back pain were included. Group A engaged in modified, specialist pilates-based exercises, whereas Group B engaged in therapeutic exercises mixed with flexibility exercises. We spent eight weeks doing the study. With a mean score of 3.93 and a standard deviation of 0.92, Group A reported less discomfort. The mean for Group B is 6.53, with a standard deviation of 0.56. Kim *et al.,* 2014 looked at how a 12-week Prop Pilates Program (PPEP) affected MSD patients' stability and level of pain. A total of 131 fruit farmers, aged between 50 and 65, who were 57 men and 74 women, willingly participated between 2009 and 2012. They went through PPEP for duration of 12 week.

After a 12-week Prop Pilates Exercise Program (PPEP), there was a noticeable decrease in the pain index (VAS). Lee *et al.*, 2014 looked at the effects of Mat Pilates and equipment on the pain and static balance of business women with chronic low back pain. Two groups of participants were created: one for mat exercises and the other for pilates apparatus exercises. They performed the Pilates routines three days a week for eight weeks. Pilates mat exercises showed greater pain alleviation and better balance when compared to pilates apparatus training.

The advantages of administering a pilates workout program in addition to yoga were studied by Susan Sorosky *et al.* (2007). 52 participants were split into two groups: 28 were assigned to yoga and pilates exercises, while 34 were given a brochure with information on back pain as a control group. Those who have done the pilates and yoga showed good improvement. A research (Hita-Contreras *et al.*, 2016) investigated the role postmenopausal women's Pilates exercise training had in avoiding falls. For ladies in their later years, pilates exercises are a useful fall management and prevention technique. It is regarded as a secure and effective method of improving static and dynamic equilibrium.

Examination of reviews

After a careful examination of the studies, the findings of all published systematic reviews (with and without meta-analysis) examining the effectiveness of pilates method exercise in reducing pain impairment in postmenopausal women with non-specific low back pain were collated. Patti *et al.*, 2015 suggested that Pilates-based exercises are better than either no treatment or very little physical exercise therapy for the treatment of chronic non-specific low back pain.

According to Wells *et al.* (2012), pilates is a mind-body training technique that requires attention to muscle control, posture, and breathing in addition to core stability, strength, and flexibility. Pilates was said to be better in 2013 by Miyamoto *et al.* than a minimal intervention. In the short term, minimal intervention is less effective than the pilates method exercises at reducing pain and disability. As a result, using the pilates method exercises to reduce pain and impairment is advised. The meta-analysis now included seven RCTs by Lim *et al.* (2010). He concluded that minimal intervention is not as effective at lowering pain in those with non-specific low back pain as Pilates-based exercises.

On the other hand, four clinical trials (n = 4) including pilates for the treatment of low back pain were reviewed by Posazzki *et al.* in 2010. Based on his study, it appears that there is some evidence to bolster the effectiveness of pilates in treating low back pain. Apart from the requirement for larger sample sizes, more accurate definitions of standard care, and comparable outcome measures, no conclusive results have been found. Because pilate's technique currently has a limited data base, it also highlights the need for bigger, more meticulously organized clinical research. Barker *et al.* (2015) investigated the effects of pilates on older adults' balance and fall risk. When compared to non-active control groups, Pilates has been shown to improve balance. The effectiveness of pilates exercises in treating chronic, non-specific low back pain and functional impairment was evaluated by (Aladro-Gonzalvo *et al.*, 2012). The results showed that pilates-based therapeutic exercise gives equivalent benefits and is moderately superior to minimum intervention for pain reduction when compared with pooled scores to another physiotherapeutic treatment. Pereira *et al.* assessed the effects of the pilates approach on individuals who had persistent low back pain in 2011.

According to the review, there was no difference in pain or functioning between the pilates and control groups. The authors note that there is not enough information to make clear conclusions about the results of their investigation, despite the fact that pilate's approach can be advised for lowering pain and impairment.

Results and Discussion

The review study revealed that pilates exercise is a significant factor in low back discomfort in women who have gone through menopause, June reports Kloubec *et al.* (2010) as stating that substantial improvements in balance and posture in 50 individuals following a 12-week period. According to Notornicola *et al.* (2014), sixty people with long-term low back pain who underwent Pilates demonstrated improvements in their overall health and vitality, their physical and social functioning, pain and impairment.

The pilates approach increases muscle endurance and strength by utilizing practical movements (Kulkarni *et al.*, 2022) week by week, the intensity of these workouts rises, leading to a significant improvement in postural control (Rodrigues *et al.*, 2010; Curnow *et al.*, 2009) demonstrated how the pilates approach enhances the pelvic load transfer process. According to the study by (Natour *et al.*, 2014) the participants using pilates method had statistically different results compared using pain medication. Latey *et al.* in 2002, pilates workout helps in muscular control, strength and flexibility. Additionally, pilates improves older ladies in quality of life and static balance (Rodrigues *et al.*, 2010; Küçükçakır *et al.*, 2013). Pilates has been shown to increase spine stabilization and to reenergize or enhance core muscle groups (Bird *et al.*, 2012; Caldwell *et al.*, 2008). According to several researches, postmenopausal women are more likely to develop sedentary behaviors and lose fitness in 2007 Sowers *et al.*, which lower quality of life, Martin *et al.* in 2009.

Table 1. The number of well-defined trials demonstrating the superiority of one specific exercise program over another in treating non-specific low back pain in postmenopausal women.

Authors study	Design	No of sample(n)	Disability measures	Intervention used	Outcomes
(Lee *et al.*, 2016)	Randomized controlled trial	74	Sit and reach test, Menopausal symptom questionnaire, Lumbar strength test, trunk lift test	Pilates exercise method	Menopausal symptoms, as well as postmenopausal women's lumbar strength and flexibility, are positively impacted by an 8-week pilates exercise program. Women who consistently engage in pilates exercise programs may have improvements in their health and capacity for independent living beyond menopause.
(Gladwell *et al.*, 2006)	Blind Randomized controlled trial	49	OLBPDQ, RMVAS, General functional status (SF- 12)	Pilates exercise vs home based exercise	Following the group intervention period, there were increases ($p<0.05$) in pain reduction, flexibility, proprioception, sports functioning, and general health in the pilates group. Pilates, which focuses on core stability via functional exercises, can assist with non-specific persistent low back pain.
(Miyamoto *et al.*, 2012)	Randomized controlled trial	8	NA	Pilates against a non-treatment group, with minimal or other types of intervention	The pilates exercises helps in reducing pain and impairment. Exercises based on the pilates method are advised for the reduction of pain and impairment.
(Patti *et al.*, 2015)	Systemic review	29	NA	NA	A critical evaluation of the literature is used in the systemic review to investigate the therapeutic efficacy of pilate's

					technique with LBP. Additionally, it provides proof that, when it comes to managing chronic low back pain the pilates method-based exercises are very helpful than neither therapy nor limited physical exercise interventions.
(Kao *et al.*, 2014)	Quasi experimental	96	Sit and reach test, electronic dynamometer	Pilates exercise method versus their own routine exercise	Twelve weeks of twice-weekly, hour-long pilates exercises might significantly improve women's trunk flexibility and lower limb muscular strength. This might serve as a helpful baseline for tracking the emergence of chronic illnesses in women and the prevention of cardiovascular disease.
(Kloubec, 2010)	Randomized controlled trial	50	Sit ups, sit and reach, push ups	Pilates exercise method versus callisthenic exercise	Active middle-aged men and women saw statistically significant improvements in their upper body muscular endurance, hamstring flexibility, and abdominal endurance after completion of 12-week Pilates exercise program.
(Patti *et al.*, 2015)	Systemic review	119	NA	NA	Pilates training technique emphasizes core stability, strength, and flexibility along with muscle control, posture, and breathing.
(Cabral *et al.*, 2014)	Randomized controlled trial	43	11 point PNRS, RMD, GPES, Tampa scale	Mat pilates training versus equipment based Pilates training	People who experience ongoing low back discomfort, pilates routines are more beneficial than a limited or control intervention, it may be more beneficial than mat pilates.
(Marshall *et al.*, 2013)	Randomized controlled trial	64	VAS, ODI, PCS FABQ	Pilates exercise versus stationary cycling exercise group	Both in the short and long term, when compared to stationary cycling, a 8-week supervised group-based pilates program produced better results.
(Pappas *et al.*, 2013)	Randomized controlled trial	28	VAS, RMD, OSWDQ , EMS stroke stand test, sit and reach test	Pilates exercise with fit ball versus no intervention	The pilates method can improve performance and quality of life for persons with low back pain when compared to no intervention.
(Anand *et al.*, 2014)	Randomized controlled trial	52	ODI, VAS	Modified pilates based exercise	In terms of pain relief, better back function, overall health, self-care, social life, and flexibility, more individuals with specific chronic low back pain benefit from the modified pilates-based exercise program than from the therapeutic exercise group.
(Luz Jr *et al.*, 2014)	Randomized controlled trial	86	11 point NRPS, RMD	Mat Pilates exercise versus equipment based Pilates exercise	In terms of disability and kinesiophobia findings, equipment-based Pilates exercise performed better than mat pilates after a six-month follow-up.
(Lim *et al.*, 2010)	Systemic review with meta-analysis	7	NA	Pilates exercises versus minimal or other interventions	Pilates-based exercises are better at reducing low back pain.
(Natour *et al.*,	Randomized	26	VAS, RMD,	Pilates method	Patients with low back pain can

2015)	controlled trial		Quality of life SF - 36, Likert scale, sit and reach	with medication versus only medication no intervention	benefit from the pilates approach in several ways, including pain, mobility and quality of life.
(Notarnicola *et al.*, 2014)	Randomized controlled trial	60	RMD, Oswetry, the SF - 36	Pilates exercise program vs inactivity	A daily pilate's routine works well for CLBP treatment.
(Pereira *et al.*, 2011)	Systemic review with meta-analysis	5	NA	Pilates method vs no exercise, lumbar stabilization	Compared to control and lumbar stabilization exercise groups, the pilates technique did not improve pain or functioning in patients with low back discomfort.
(Gagnon, 2005)	Randomized controlled trial	12	VAS, ODI, AROM	Pilates exercise program	The study tells that the use of pilates movements as a therapeutic exercise intervention helped to decrease the pain.
(Martínez-Amata *et al.*, 2015)	Randomized controlled trial	50	FES,TUG test, NRPS	Physiotherapy treatment with Pilates versus Physiotherapy treatment alone	For Spanish women over 65 with CLBP, six weeks of pilates training may help prevent falls by improving FOF, functional balance, and discomfort
(Campos de Oliveira *et al.*, 2018)	Randomized controlled trial	51	A BMD (a dual energy X ray absorptiometry)	Whole body vibration vs pilates exercise	A six-month regimen of three weekly WBV or pilates sessions had an equivalent impact on BMD in postmenopausal women.
(Posadzki *et al.*, 2010)	Systemic Review	4	NA	Pilates method	Larger and more carefully planned clinical trials are consequently required because the evidence base for the Pilates approach is still limited.
(Hita-Contreras *et al.*, 2016)	Randomized controlled trial	NA	NA	Pilates exercise training	Pilates exercises are a helpful strategy for managing and preventing falls in women in their latter years of life. It can be considered a safe and efficient way to enhance both dynamic and static balance.
(Oliveira *et al.*, 2019)	Randomized controlled trial	37	NRPS, SF, Sit to stand test, 10 meter walk test, RMD	Pilates exercise group versus aerobic exercise group	The study using pilates may lessen discomfort in older persons with chronic low back pain, improving their function and balance as a result.
(Barker *et al.*, 2015)	Systemic review	6	NA	NA	In older persons, pilates is beneficial in improving balance, which may lower their risk of falling, as compared to a non-active control group.
(Hyun *et al.*, 2014)	Randomized controlled trial	40	TUG test, sway length, sway speed, center of foot pressure for one minute	Pilates Mat exercise and (PME) versus unstable support surface exercise(USSE)	The balance abilities of senior female individuals were shown to be significantly improved by PME and USSE, indicating that these exercises are useful in improving balance in this particular set of patients. On the other hand, exercising on a pilates mat is thought to be safer than exercising on an erratic surface.
(Bird *et al.*, 2012)	Randomized cross over	32	Sway, timed up and go, four square step test	Pilates training vs usual training	Good balance both static and dynamic was attained by study participants who engaged in the pilates component.
(Sorosky *et al.*, 2007)	Systemic review	52	ODI, BDI, SR FR VAS	Yoga and pilates versus back pain	yoga and pilates are more beneficial for treating

				educational booklets	individuals with low back pain
(Cabral *et al.*, 2014)	Randomized controlled trial	66	SF- 36, RSS, Body cathexis scale, BDS, VAS	Pilates exercise method with verbal education versus no treatment	Exercise beliefs, physical and psychological factors can be effectively changed by clinical pilates and verbal teaching.
(Lee *et al.*, 2014)	Randomized controlled trial	40	BPM, VAS	Pilates Mat exercise method versus Pilates apparatus exercise	When compared to pilates apparatus training, pilates mat exercise demonstrated a higher degree of pain relief and improved balance.
(Aladro-Gonzalvo *et al.*, 2012)	Randomized controlled trial	19	NA	Pilates with Placebo, minimal intervention or another physiotherapeutic treatment	When compared with another physiotherapeutic treatment, Pilates-based therapeutic exercise are somewhat better than minimal intervention for pain reduction.
(Rydeard *et al.*, 2006)	Randomized controlled trial	55	NRS 101, RMD	Pilates training with no treatment	Pilates method proved effective in treating a group of people with non-specific chronic low back pain.
(Miyamoto *et al.*, 2012)	Randomized controlled trial	86	11 point PNRS, RMD, Tampa scale	Pilates training with educational booklet versus education alone	The modified pilates movements were better to an educational booklet alone.
(Donzelli *et al.*, 2006)	Randomized controlled trial	53	OLBPDQ, VAS	Pilates cova tech method versus Back school method	Instead of traditional treatments for non-specific low back pain pilates' cova tech technique is better.
(Miyamoto *et al.*, 2013)	Randomized controlled trial	32	Berg Balance scale, TUG Test, Health survey SF-36	Pilates exercise method versus static exercise stretching	The pilates showed significant differences ($p<0.05$) before and after the exercise programs.
(Kim *et al.*, 2014)	Randomized controlled trial	131	VAS	Prop pilates exercise program	Both male and female fruit producers showed a good improvement in their body stability, following a 12-week Prop Pilates Exercise Program (PPEP).
(Ravindran *et al.*, 2022)	Randomized controlled trial	47	NPRS, RM	Pilates exercise program versus aerobic program	Pilates training outperforms aerobic exercise in decreasing pain and improving functional ability in postmenopausal women having low back pain
(Chang and Lai, 2013)	Randomized controlled trial	327	MRS, HRV	Heart rate variability during exercise	The ANS adjustment and women's postmenopausal symptoms were impacted by variations in exercise activity. Women's postmenopausal symptoms could be lessened if they changed how they exercised. Middle-aged women's menopausal symptoms can be lessened by exercise.
(Pereira *et al.*, 2011)	Randomized controlled trial	60	SR, Bio feedback	Pilates and core stabilization	When it comes to helping postmenopausal women become more flexible and strong, pilates training is superior to the core stabilization technique.

According to Curnow *et al.* (2009), postmenopausal women like adopting the prescribed approach of Pilates exercises to improve their control and posture. Marini *et al.* (2017) state that it is imperative that these women change their sedentary lives by becoming physically active. A pilates exercise regimen can successfully relieve pain while improving lumbar strength and flexibility, according to a 2016 research

by Lee *et al.* (2016). In conclusion, it is often unclear how much physical activity, how often, how intense, and how much labor goes into the Pilates programs that are used. Table 1 indicates that the number of well-defined trials demonstrating the superiority of one specific exercise program over another in treating non-specific low back pain in postmenopausal women is rather small. In this domain, specialists concur that exercises based on the pilates technique are more effective than either no therapy or other therapies in treating nonspecific low back pain in postmenopausal women. Further study is needed to find out more about the advantages of a Pilates exercise program on lowering low back pain in postmenopausal women.

References

Aladro-Gonzalvo AR, Araya-Vargas GA, Machado-Díaz M, Salazar-Rojas W. 2012. Pilates-based exercise for persistent, non-specific low back pain and associated functional disability: a meta-analysis with meta-regression. J Bodyw Mov Ther **17**, 125–136. DOI: 10.1016/j.jbmt.2012.08.003

Anand UA, Caroline PM, Arun B, Gomathi GL. 2014. A study to analyze the efficacy of modified Pilates-based exercises and therapeutic exercises in individuals with chronic nonspecific low back pain: a randomized controlled trial. Int J Physiother Res **2**, 525–529.

Barker AL, Bird ML, Talevski J. 2015. Effect of Pilates exercise for improving balance in older adults: a systematic review with meta-analysis. Arch Phys Med Rehabil **96**, 715–723.
DOI: 10.1016/j.apmr.2011.08.005

Bird ML, Hill KD, Fell JW. 2012. A randomized controlled study investigating static and dynamic balance in older adults after training with Pilates. Arch Phys Med Rehabil **93**, January 2012.
DOI: 10.1016/j.apmr.2011.08.005

Bird ML, Hill KD, Fell JW. 2012. A randomized controlled study investigating static and dynamic balance in older adults after training with Pilates. Arch Phys Med Rehabil **93**, 43–49.
DOI: 10.1016/j.apmr.2011.08.005

Cabral MN, Manzoni ACT, Oliveira NTB, Costa C, Fuhro FF, Luz MA, Pena LO. 2014. Effectiveness of mat Pilates or equipment-based Pilates exercises in patients with chronic nonspecific low back pain: a randomized controlled trial. Phys Ther **94**, 623–631. DOI: 10.2522/ptj.20130277

Caldwell K, Harrison M, Adams M, Triplett NT. 2008. Effect of Pilates and taiji quan training on self-efficacy, sleep quality, mood, and physical performance of college students. J Bodyw Mov Ther **13**, 155–163. DOI: 10.1016/j.jbmt.2007.12.001

Campos de Oliveira L, Gonçalves de Oliveira R, Pires-Oliveira DA. 2015. Effects of Pilates on muscle strength, postural balance and quality of life of older adults: a randomized, controlled, clinical trial. J Phys Ther Sci **27**, 871–876.
DOI: 10.1589/jpts.27.871

Campos de Oliveira L, Gonçalves de Oliveira R, Pires-Oliveira DA. 2018. Effects of whole-body vibration versus Pilates exercise on bone mineral density in postmenopausal women: a randomized and controlled clinical trial. J Geriatr Phys Ther.
DOI: 10.1519/JPT.0000000000000184

Chang WD, Lai PT. 2013. Different exercise behaviors influence heart rate variability, autonomic nerve system function, and menopausal symptoms in post-menopausal women. J Phys Ther Sci **25**, 477–481.

Curnow D, Cobbin D, Wyndham J, Choy BST. 2009. Altered motor control, posture, and the Pilates method of exercise prescription. J Bodyw Mov Ther **13**, 104–111. DOI: 10.1016/j.jbmt.2008.06.013

Donzelli S, Di Domenica F, Cova AM, Galletti R, Giunta N. 2006. Two different techniques in the rehabilitation treatment of low back pain: a randomized controlled trial. Euro Medicophys **42**, 205–210.

Gagnon LH. 2005. Efficacy of Pilates exercises as therapeutic intervention in treating patients with low back pain. TRACE, University of Tennessee, Knoxville.

Gladwell V, Head S, Haggar M, Beneke R. 2006. Does a program of Pilates improve chronic non-specific low back pain? J Sport Rehabil **15**, 338–350. DOI: 10.1123/jsr.15.4.338

Hayden JA, van Tudler MW, Malmivaara AV, Koes BW. 2005. Exercise therapy for non-specific low back pain. Ann Intern Med **142**, 765–775.
DOI: https://doi.org/10.7326/0003-4819-142-9-200505030-00013

Hita-Contreras F, Martínez-Amat A, Cruz-Díaz D, Pérez-López FR. 2016. Fall prevention in postmenopausal women: the role of Pilates exercise training. Climacteric.
DOI: 10.3109/13697137.2016.1139564

Hughes RE, Nancy AN. 2009. Estimating investment worthiness of an ergonomic intervention for preventing low back pain from a firm's perspective. Appl Ergon **40**, 457–463.
DOI: 10.1016/j.apergo.2008.10.004

Hyun J, Hwangbo K, Lee CW. 2014. The effects of Pilates mat exercise on the balance ability of elderly females. J Phys Ther Sci **26**, 291–293. DOI: 10.1589/jpts.26.291

Kao YH, Liou TH, Huang YC, Tsai YW, Wang KM. 2014. Effects of a 12-week Pilates course on lower limb muscle strength and trunk flexibility in women living in the community. Health Care Women Int. DOI: 10.1080/07399332.2014.900062

Kim HJ, Nam SN, Bae UR, Hwang R, Lee JB, Kim JH. 2014. The effect of 12 weeks Prop Pilates exercise program (PPEP) on body stability and pain for fruit farmers with MSDs. Technol Health Care **22**, 359–367. DOI: 10.3233/THC-140792

Kloubec JA. 2010. Pilates for improvement of muscle endurance, flexibility, balance, and posture. J Strength Cond Res **24**, 661–667.
DOI: 10.1519/JSC.0b013e3181c277a6

Küçük F, Livanelioglu A. 2015. Impact of clinical Pilates exercises and verbal education on exercise beliefs and psychosocial factors in healthy women. J Phys Ther Sci **27**, 3437–3443.
DOI: 10.1589/jpts.27.3437

Küçükçakır N, Altan L, Korkmaz N. 2013. Effects of Pilates exercises on pain, functional status, and quality of life in women with postmenopausal osteoporosis. J Bodyw Mov Ther **17**, 204–211.
DOI: 10.1016/j.jbmt.2012.07.003

Kulkarni SR, Honkalas P, Golhar S. 2022. Effect of Pilates and core stabilization exercises on flexibility and strength in postmenopausal females: an experimental study. Int J Phys Educ Sports Health **9**, 97–102.

Kung J, Chiappelli F, Cajulis OO. 2010. From systematic reviews to clinical recommendations for evidence-based health care: validation of Revised Assessment of Multiple Systematic Reviews (R-AMSTAR) for grading of clinical relevance. Open Dent J **4**, 84–91.
DOI: 10.2174/1874210601004020084

Latey P. 2002. Updating the principles of the Pilates method part 2. J Bodyw Mov Ther **6**, 94–101. DOI: 10.1054/jbmt.2002.0289

Lee CW, Hyun J, Kim SG. 2014. Influence of Pilates mat and apparatus exercises on pain and balance of businesswomen with chronic low back pain. J Phys Ther Sci **26**, 475–477.
DOI: 10.1589/jpts.26.475

Lee H, Caguicla JM, Park S. 2016. Effects of 8-week Pilates exercise program on menopausal symptoms and lumbar strength and flexibility in postmenopausal women. J Exerc Rehabil **12**, 247–251. DOI: 10.12965/jer.1632630.315

Lee H, Caguicla JM, Park S, Kwak DJ, Won DY, Park Y, Kim J, Kim M. 2016. Effects of 8-week Pilates exercise program on menopausal symptoms and lumbar strength and flexibility in postmenopausal women. J Exerc Rehabil
DOI: 10.12965/jer.1632630.315

Lim ECW, Poh RL, Low AY, Wong WP. 2010. Effects of Pilates-based exercises on pain and disability in individuals with persistent nonspecific low back pain: a systematic review with meta-analysis. J Orthop Sports Phys Ther **41**, 70–80.
DOI: 10.2519/jospt.2011.3393

Luz MA, Pena Costa LO, Fuhro FF, Manzoni ACT, Oliveira NTB, Cabral CMN. 2014. Effectiveness of mat Pilates or equipment-based Pilates exercises in patients with chronic nonspecific low back pain: a randomized controlled trial. Phys Ther, J. January 16, 2014.
DOI: 10.2522/ptj.20130277

Marini M, Bendinelli B, Assedi M, Occhini D, Castaldo M, Fabiano J. 2017. Low back pain in healthy postmenopausal women and the effect of physical activity: a secondary analysis in a randomized trial. PLoS One **12**, e0177370.
DOI: 10.1371/journal.pone.0177370

Marshall PWM, Kennedy S, Brooks C, Lonsdale C. 2013. Pilates exercise or stationary cycling for chronic nonspecific low back pain: does it matter? A randomized controlled trial with 6-month follow-up. Spine **38**, E952–E959.
DOI: 10.1097/BRS.0b013e318297c1e5

Martin CK, Church TS, Thompson AM, Earnest CP, Blair SN. 2009. Exercise dose and quality of life: a randomized controlled trial. Arch Intern Med **169**, 269–278.
DOI: 10.1001/archinternmed.2008.545

Martínez-Amata A, De la Torre-Cruz MJ, Casuso RA, Mendoza Ladrón de Guevara N, Hita-Contreras F. 2015. Effects of a six-week Pilates intervention on balance and fear of falling in women aged over 65 with chronic low-back pain: a randomized controlled trial. Maturitas **82**, 371–376.
DOI: 10.1016/j.maturitas.2015.07.022

Miyamoto GC, Costa LO, Cabral CMN. 2013. Efficacy of the Pilates method for pain and disability in patients with chronic nonspecific low back pain: a systematic review with meta-analysis. Braz J Phys Ther **17**, 517–532.
DOI: http://dx.doi.org/10.1590/S1413-35552012005000127

Miyamoto GC, Pena Costa LO, Galvanin T, Cabral CMN. 2012. Efficacy of the addition of modified Pilates exercises to a minimal intervention in patients with chronic low back pain: a randomized controlled trial. Phys Ther J Published online,
DOI: 10.2522/ptj.20120190

Mother D, Liberati A, Tetzlaff J, Altman DG, PRISMA Group. 2009. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: the PRISMA statement. Ann Intern Med **151**, 264–269.
DOI: 10.1371/journal.pmed.1000097

Natour J, Cazotti LD, Ribeiro LH. 2014. Pilates improves pain, function, and quality of life in patients with chronic low back pain: a randomized controlled trial. Clin Rehabil **28**, 659–669.
DOI: 10.1177/0269215514538981

Natour J, de Araujo Cazotti L, Ribeiro LH, Baptista AS, Jones A. 2015. Pilates improves pain, function and quality of life in patients with chronic low back pain: a randomized controlled trial. Clinical Rehabilitation **29**, 59–68.
DOI: 10.1177/0269215514538981

Notarnicola A, Fischetti F, Maccagnano G, Comes R, Tafuri S, Moretti B. 2013. Daily Pilates exercise or inactivity for patients with low back pain: a clinical prospective observational study. Eur Spine J **50**, 59–66.

Oliveira NTB, Ricci NA, Santos FR, Salvador EME, Almeida ICB, Cabral CMN. 2019. Effectiveness of the Pilates method versus aerobic exercises in the treatment of older adults with chronic low back pain: a randomized controlled trial protocol. BMC Musculoskelet Disord **20**, 250.
DOI: https://doi.org/10.1186/s12891-019-2642-9

Pappas E, Panou H, Souglis A. 2013. The effect of a Pilates exercise program using fitball on people suffering from chronic low-back pain in terms of pain reduction and function improvement. J Phys Educ Sport **13**, 606–611. DOI: 10.7752/jpes.2013.04095

Patti A, Bianco A, Paoli A, Messina G, Montalto MA, Bellafiore M, Battaglia G, Iovane A, Palma A. 2015. Effects of Pilates exercise programs in people with chronic low back pain: a systematic review. Medicine **94**, 1.
DOI: 10.1097/MD.0000000000000383

Pereira LM, Obara K, Dias JM, Menacho MO, Guariglia DA, Schiavoni D, Pereira HM, Cardoso JR. 2012. Comparing the Pilates method with no exercise or lumbar stabilization for pain and functionality in patients with chronic low back pain: a systematic review and meta-analysis. Clin Rehabil **26**, 10. DOI: 10.1177/0269215511411113

Posadzki P, Lizis P, Hagner-Derengowska M. 2010. Pilates for low back pain: a systematic review. Complement Ther Clin Pract **16**, 174–181.
DOI: 10.1016/j.ctcp.2010.09.005

Ravindran AK, Javed J, Parthiban R, Sherrif B. 2022. Effectiveness of aerobic exercise versus Pilates in postmenopausal women with non-specific chronic low back pain. Indian J Physiother Occup Ther **16**, 1.
DOI: https://doi.org/10.37506/ijpot.v16i2.18026

Rodrigues BGS, Cader SA, Torres NVO, Oliveira EM, Dantas EHM. 2010. Pilates method in personal autonomy, static balance, and quality of life of elderly females. J Bodyw Mov Ther **14**, 195–202. DOI: 10.1016/j.jbmt.2009.12.005

Rydeard R, Leger A, Smith D. 2006. Pilates-based therapeutic exercise: effect on subjects with nonspecific chronic low back pain and functional disability. J Orthop Sports Phys Ther **36**, 472–484. DOI: 10.2519/jospt.2006.2144

Rydeard R, Leger A, Smith D. 2006. 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 **36**, 472–484.
DOI: 10.2519/jospt.2006.2144

Sorosky S, Stilp S, Akuthota V. 2007. Yoga and Pilates in the management of low back pain. Curr Rev Musculoskelet Med **1**, 39–47.
DOI: 10.1007/s12178-007-9004-1

Sowers M, Zheng H, Tomey K, Karvonen-Gutierrez C, Jannausch M, Li X, Yosef M, Symons J. 2007. Changes in body composition in women over six years at midlife: ovarian and chronological aging. J Clin Endocrinol Metab **92**, 895–901. DOI: 10.1210/jc.2006-1393

Van Tudler MW, Tuut M, Pennick V, Bombardier C, Assendelft WJ. 2004. Quality of primary care guidelines for acute low back pain. Spine **29**, 357–362.
DOI: 10.1097/01.brs.0000137056.64166.51

Wells C, Kolt GS, Bialocerkowski A. 2012. Defining Pilates exercise: a systematic review. Complement Ther Med **20**, 253–262.
DOI: 10.1016/j.ctim.2012.02.005