

Effect of Pilates based exercises on symptomatic knee osteoarthritis: A Randomized Controlled Trial

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Abstract

Objective: To determine the effects of Pilates exercises on pain, knee range of motion and functional disability in women with knee osteoarthritis.

Method: The double-blind randomised controlled trial was conducted at the National Orthopaedic Hospital, Bahawalpur, Pakistan, from April to September 2018, and comprised female patients with knee osteoarthritis. The subjects were selected and randomised into control group A receiving isometrics and intervention group B receiving Pilates exercises. Both groups received one-hour sessions 3 times per week for 8 weeks. The groups were assessed at baseline and at the end of the 8th week using numeric pain rating scale and Western Ontario and McMaster Universities osteoarthritis index for pain and functionality level respectively. Data was analysed using SPSS 23.

Results: Of 44 patients, there were 22(50%) in each of the two groups. Mean age of group B was 57.60 ± 6.34 years, and it was 55.65 ± 7.28 in group A. Mean body mass index of group B was 25.812 ± 4.16 , and it was 26.93 ± 4.4 in group A. The study was completed by 40(91%) patients; 20(50%) in each of the two groups. Both groups showed significant improvement for pain, range of motion and physical function post-intervention ($p < 0.05$). Group B showed significantly more improvement in terms of pain and physical function compared to group A ($p < 0.05$).

Conclusion: Pilates exercises were found to be more effective in the treatment of patients with knee osteoarthritis.

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Introduction

The knee joint is said to be the most complex joint of the body which solely controls the major movements and provides stability to the body. It is most vulnerable to pathologies like osteoarthritis (OA) and other degenerative changes with age. Osteoarthritis is the most common wear and tear pathology of joints occurring in females. The commonness of knee osteoarthritis (KOA), with 85% of the people aged 65, is most noteworthy, as it is a degenerative and dynamic pathological state of the ligament in the joints.¹ This joint has a complex structure and the anatomical features of knee, specifically the locking phenomenon, is distinctive of all that should be strengthened using physical activity to enable to maintaining its power to bear loads.² Numerous debilitations are connected with KOA, like torment, firmness, swelling, diminished range of motion (ROM),

unsteadiness, distortion in serious cases, diminished utilitarian movement, adjustment shortages and decreased personal satisfaction. The significant hazard factors for OA are advanced age, hereditary factors, solid shortcoming in quadriceps muscles, high body mass index (BMI) and injury, rehashed utilisation of the joint and inactive lifestyle.³ Recent literature also focussed on fatigability factors relating to KOA.⁴ It is more typical in females, and obesity, multiple pregnancies, lower BMI related to lower calcium intake are supposed to be the major causes of its higher prevalence. The prevalence in Pakistan was found to be 9.6% among male and 18% among females.⁵

Amongst the present treatment available for OA, there are pharmacological as well as non-pharmacological methods. Lately, notwithstanding routine pharmacological treatment, preservationist medicines and physiotherapy have been used.⁶ Hip and KOA are the major causes of disability that affects daily activities and impacts health due to stiffness and pain.⁷ Amongst the physical therapy interventions used for KOA, knee isometrics are the exercises that are most widely used and have maximal effectiveness in treating the pain and increasing the knee ROM.⁸

Isometric exercises are known to be the most appropriate conventional treatment that stops the progression of degeneration within the involved joint.⁹ The use of lateral

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wedge is also effective in reducing pain and improving quality of life (QOL).¹⁰ Electrotherapeutic interventions are used due to its effectiveness in reducing pain and increasing ROM. Apart from all the conventional treatments to treat KOA, a set of exercises, known as Pilates, is being widely used nowadays. Pilates exercises are highly recommended for reducing pain and strengthening peripheral muscles. Pilates is a physical wellness framework created in the mid-20th century by Joseph Pilates after whom it was named. Pilates called his technique "Contrology".¹¹ Pilates enhances adaptability, assembles quality and creates control and perseverance in the whole body.¹² The Pilates strategy is an extensive body-moulding technique that is coordinated to improve both the body and the mind of the individual.¹³ Moreover, the Pilates are known to have immense toning and strengthening benefits even if done at a moderate level, though they are practiced at low level. Pilates technique makes it exceptional in the fitness world.¹⁴ KOA is known to be one of the most common pathologies of joints in Pakistan, especially among the females. In order to control this count, the physicians and the physical therapists need to introduce cost-effective and productive measures for the patients.¹⁵

Pilates and isometrics both are used for treatment of KOA and have shown effectiveness. However, their comparative effectiveness is not well-known in the target population as demographic variations affect the outcomes. The current study was planned to compare the effectiveness of Pilates exercises with isometric exercises on pain, ROM and functional disability of KOA female patients.

Patients and Methods

The double-blind randomised clinical trial (RCT) was conducted at the National Orthopaedic Hospital, Bahawalpur, Pakistan, from April to September 2018. After approval from the institutional ethics review committee, the sample size was calculated using G-Power calculator version 3.1.9.2.¹⁶ while taking post-treatment mean physical QOL scores of KOA patients as 52.49 ± 11.13 for the isometrics group and 49.77 ± 17.95 for the Pilates group.¹⁷ The sample size was inflated to cover up for 10% attrition rate.

The sample was raised using non-probability convenience sampling technique from among females aged 35-65 years with unilateral or bilateral KOA having grade II or III on Kellgren and Lawrence classification.¹⁸ Those having had knee surgery, like total knee replacement (TKR), intra-articular steroid injection in the preceding 6 months, use of assistive devices disease, cardio-respiratory dysfunctions, neurological condition, like numbness or tremors, affecting

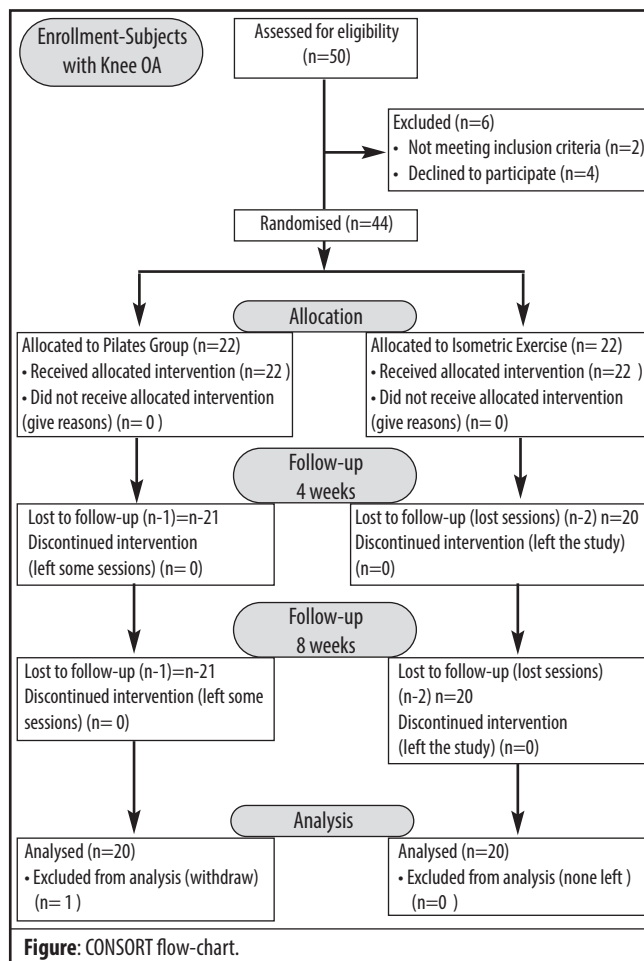
the lower limbs and balance were excluded. Only females were included because of ethical and cultural issues and comfort zone of the participants during the exercise sessions. After taking informed consent from the patients and permission from the hospital administration the patients were randomised into control group A receiving isometrics and intervention group B receiving Pilates exercises. The randomisation was done using an online computerised random number generator (*random.org*).¹⁹ The biostatistician and the patients were kept blinded to the randomisation. Both groups received one-hour sessions 3 times per week for 8 weeks. Data was collected from each participant at baseline level and an administrative assistant allocated interventions via opaque sealed envelope marked according to the allocation schedule. Before the randomisation, an examiner performed the subjective examination for pain and physical disability of the subjects. Pain was measured using the Numeric pain rating scale (NPRS). Goniometer was used to assess knee joint ROM, while Western Ontario & McMaster University osteoarthritis index (WOMAC) was used to assess functional ability of the patients.²⁰ The first section had 5 questions regarding pain; each having a maximum score of 4, thus a total of 20. The second section had two questions regarding knee stiffness and had a total score of 8. The last section of the questionnaire had 17 items that carried a score of 68 in total.²¹ Group A was given hot-pack treatment for 7-10 minutes. Transcutaneous electrical nerve stimulation (TENS) for 10 minutes and quadriceps, strengthening and hamstring stretching exercises for 8 weeks. Group B was given hot-pack treatment for 7-10 minutes. TENS for 10 minutes and quadriceps strengthening and hamstring stretching exercises plus Pilates exercises. Each session comprised 10 minutes as warm-up, 40 minutes of exercise and 10 minutes as cooling off. Group B exercises contained postural training, relaxation, stretching, balance, breath and strength exercises. Quadriceps and gluteus strengthening exercises included bridging, squats with ball, and lateral band walk. Stretches to improve flexibility, followed by hip flexor, gluteus, seated hamstring and quads stretch. In week 1, patients performed hundred in 5 repetitions and 2 sets. In weeks 2 and 3 the patients additionally performed one-leg stretch and double-leg stretch in 6 repetitions and 2 sets. In week 4, 7 repetitions of clams were made. In weeks 5 and 6 there was addition of 2 sets of one-leg kick. In week 7, the patients additionally performed 8 repetitions of sidekicks. In week 8, addition of 10 repetitions of one-leg circle was made.¹⁸ Detailed reassessment was done at baseline, end of 4th week and post-intervention at the end of the 8th week. A semi-structured questionnaire was used to collect data.

Data was analysed using SPSS 23. Shapiro Wilk's test confirmed that data was normally distributed. As the data was parametric, repeated measurement analysis of variance (ANOVA) was used for intra-group analysis, and independent sample t test was used for inter-groups comparisons. $P < 0.05$ was taken as significant.

Results

Of 44 patients, there were 22(50%) in each of the two groups. Mean age of group B was 57.60 ± 6.34 years, and it was 55.65 ± 7.28 in group B. Mean BMI of group B was 25.81 ± 4.16 , and it was 26.93 ± 4.4 in group A. The study was completed by 40(91%) patients; 20(50%) in each of the two groups (Figure). Hypertension was present in 13(32.50%) cases, diabetes mellitus in 14(35%) and 13(32.50%) had backache along with KOA. All such patients were asked to continue the medications as their usual routine. Baseline assessment showed more significant difference in characteristics (Table 1). Both groups showed significant improvement for pain, ROM and physical function post-intervention ($p < 0.05$) (Table 2).

Group B showed significantly more improvement in terms



of pain and physical function compared to group A ($p < 0.05$) (Table 3).

Table-1: Group characteristics at baseline (0–Week).

Variables (Outcomes)	Group of the Patient	Mean±SD	p-value
Age (years)	Pilates	57.60±6.34	0.37
	Isometrics	55.65±7.28	
Body Mass Index	Pilates	25.81±4.16	0.40
	Isometrics	26.93±4.28	
NPRS	Pilates	7.85±1.53	0.47
	Isometrics	8.20±1.50	
Knee Flexion Range	Pilates	79.00±5.98	0.27
	Isometrics	77.00±5.47	
WOMAC Index	Pilates	15.35±0.98	0.31
	Isometrics	17.40±0.75	

NPRS: Numeric pain rating scale; WOMAC: Western Ontario & McMaster University Osteoarthritis Index; SD: Standard Deviation.

Table-2: Intra-group comparison of outcomes.

Outcomes	Evaluation	Pilates Mean±SD	Isometrics Mean±SD	p-value
Numeric Pain Rating	Week 0	7.85±1.53	8.20±1.50	0.01
	Week 4	5.00±1.02	5.10±1.02	
	Week 8	2.55±2.08	4.00±1.02	
Knee flexion (Degrees)	Week 0	79.00±5.98	77.00±5.47	0.00
	Week 4	86.75±6.54	85.00±6.28	
	Week 8	94.50±4.26	88.50±6.70	
WOMAC Index	Week 0	15.35±0.98	17.40±0.75	0.00
	Week 4	14.45±0.94	16.00±0.79	
	Week 8	12.65±1.38	14.05±0.99	

WOMAC: Western Ontario & McMaster University Osteoarthritis Index; SD: Standard Deviation.

Table-3: Inter-group comparison of outcomes (n=20).

Outcomes	Evaluation	Pilates Mean±SD	Isometrics Mean±SD	p-value
Numeric Pain Rating	0 week	7.85±1.53	8.20±1.50	0.47
	8 week	2.55±2.08	4.00±1.02	0.01
Knee flexion (Degrees)	0 week	79.00±5.98	77.00±5.47	0.27
	8 week	94.50±4.26	88.50±6.70	0.00
WOMAC Index	0 week	73.80±4.03	77.10±4.47	0.31
	8 week	56.95±7.69	65.85±7.29	0.00

WOMAC: Western Ontario & McMaster University Osteoarthritis Index; SD: Standard Deviation.

Discussion

The current study showed that Pilates exercise regime improved pain and functional outcomes in KOA patients, which is in line with literature.^{13,21}

The basic theme behind Pilates Exercise is the general status and progression of adaptability, that can start muscles fibres to practice the movements.²² In patients with OA, the shortcoming of quadriceps and its quality of movement with hamstring is thought to be the expected variation from normal mechanics that effect the knee joint.¹⁵

Though no specific group of muscles was assessed in the current study, the flexion significantly improved which indicates the positive impact of Pilates exercises.

The Lequesne score list is a 10-item index for pain, walking distance and activities of daily living in KOA subjects, with low scores showing less impairment in functions.²³ Pilates technique is based on breathing with fixation, which is one of the standard methods of its application. This fixation can initiate homeostatic control of muscles and ensures the physiological movements.²⁴ The initiation of muscle shafts can be extended and that can cause all these unpredictable changes.²⁵

Patients reported improvement in postural and core stability with development of endurance which show the importance of Pilates programme.²⁶ Pilates exercises are easy to perform, and phobic patients can also be managed, especially females of older age. The subjects with OA have phobias due to pain that should be considered.²⁷

In the current study, pain ($p=0.01$), WOMAC ($p=0.01$) and knee flexion ($p=0.001$) improved significantly more in Pilates group compared to the isometric group. Comparing the results with another study based on Pilates showed significant effect compared to isometric for functional disability, pain and ROM ($p=0.001$).²⁸ Pilates had significant effects on balance, strength and postural sway even in initial phases and decreased the risk of fall in another study.²⁹

The small sample size and the female-only sample are limitations of the current study and affect the generalisability of the results.

Conclusion

Pilates exercises were found to be more effective in treating KOA patients, and should be practised widely.

Disclaimer: The text is based on an academic thesis.

Conflict of Interest: None.

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References

1. Kloubec JA. Pilates for improvement of muscle endurance, flexibility, balance, and posture. *J Strength Cond Res*. 2010; 24:661-7.
2. Losina E, Silva GS, Smith KC, Collins JE, Hunter DJ, Shrestha S, et al. Quality-Adjusted Life-Years Lost Due to Physical Inactivity in the United States Osteoarthritis Population. *Arthritis Care Res*. 2019; 72:1349-57.
3. Bird ML, Hill KD, Fell JW. A randomized controlled study investigating static and dynamic balance in older adults after training with Pilates. *Arch Phys Med Rehabil*. 2012; 93:43-9.
4. Osama M, Babur N, Siddiqi FA. Walking related performance fatigability in persons with knee osteoarthritis; an important yet neglected outcome. *J Pak Med Assoc*. 2021; 2:1-5.
5. WHO World Health Organization: The WHO register. [Online] [Cited 2019 February 20]. Available from: URL: <https://www.who.int/chp/topics/rheumatic/en/>.
6. Aghajani A. The Effect of Eight Weeks Selected Exercises on Balance Indexes in Elderly Patients with Knee Osteoarthritis. *J Paramed Sci Rehabil*. 2017; 6:86-97.
7. Taj S, Tayaba H. A comparison of health-related quality of life among knee osteoarthritis patients in two cities in Pakistan. *Clin Surg Res Commun*. 2019; 3:20-5.
8. Anderson BD, Spector A. Introduction to Pilates-based rehabilitation. *Orthopaed Phys Ther Clin North Am*. 2000; 9:395-410.
9. Lambova S. Exercise programmes for osteoarthritis with different localization. *Curr Rheumatol Rev*. 2018; 14:123-30.
10. Abdul Salam TM, Awan WA. Application of Lateral Wedge in Knee Osteoarthritis for Improving Pain and Quality of Life. *J Liaquat Univ Med Health Sci*. 2019; 18:146-51.
11. Bernardo LM. The effectiveness of Pilates training in healthy adults: An appraisal of the research literature. *J Bodyw Mov Ther*. 2007; 11:106-10.
12. Altan L, Korkmaz N, Dizdar M, Yurtkuran M. Effect of Pilates training on people with ankylosing spondylitis. *Rheumatol Int*. 2012; 32:2093-9.
13. Mehdi E, Hossein M, Sadredin SS, Heidar S. Effects Of Pilates Exercise On Knee Osteoarthritis In Elderly Male Athletes. *J Res Rehabil Sci*. 2011; 7:571-9.
14. Bullo V, Bergamin M, Gobbo S, Sieverdes J, Zaccaria M, Neunhaeuserer D, et al. The effects of Pilates exercise training on physical fitness and wellbeing in the elderly: a systematic review for future exercise prescription. *Prev Med*. 2015; 75:1-11.
15. De Oliveira LC, De Oliveira RG, De Almeida Pires-Oliveira DA. Effects of Pilates on muscle strength, postural balance and quality of life of older adults: a randomized, controlled, clinical trial. *J Phys Ther Sci*. 2015; 27:871-6.
16. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods*. 2007; 39:175-91.
17. Najafabadi MT, Mahdaveinejad R, Ghasemi AG. Comparison of isometric and Pilates exercises on Knee pain and quality of life in women with Knee Osteoarthritis. *Asian J Multidiscip Stud*. 2014; 1:38-41.
18. Iqbal MN, Haidri FR, Motiani B, Mannan A. Frequency of factors associated with knee osteoarthritis. *J Pak Med Assoc*. 2011; 61:786.
19. Mads Haahr, Svend Haahr; Danish Nationals. Randomness and Integrity Services Ltd© 1998-2021 RANDOM.ORG. [Online] [Cited 2018 January 13]. Available from: URL: <https://www.random.org/company/>.
20. Muhammad A, Azam MJ, Salam A. Impact On Quality Of Life In Patients With Knee Osteoarthritis In Faisalabad. *J Univer Med Dent Coll*. 2018; 9:49-52.
21. Rahbar M, Shimia M, Toopchizadeh V, Abed M. Association between knee pain and low back pain. *J Pak Med Assoc*. 2015; 65:626-31.
22. Baltaci G, Tunay VB, Duzgun I, Ozer D, Yakut E. 523 Comparison Of Strength, Functional Outcome And Proprioceptive Ability After Pilates-Based Exercise Program In Women Patients With Knee Osteoarthritis And Healthy Women. *Osteoarth Cartil*. 2008:S223.
23. Johnson EG, Larsen A, Ozawa H, Wilson CA, Kennedy KL. The effects of Pilates-based exercise on dynamic balance in healthy adults. *J bodyw Mov Ther*. 2007; 11:238-42.
24. Dai WL, Lin ZM, Guo DH, Shi ZJ, Wang J. Efficacy and safety of Hylan versus hyaluronic acid in the treatment of knee osteoarthritis. *J Knee Surg*. 2019; 32:259-68.
25. Jafari M, Ghasemi G, Motifard M, Zolaktaf V, Rahimi N. The Effect of Pilates Exercises on Pain, Outcomes, and Quality of Life of the Patients with Total Knee Replacement. *Sadra Med J*. 2014; 3: 1-12.

26. Abasıyanık Z, Ertekin Ö, Kahraman T, Yigit P, Özakbaş S. The effects of Clinical Pilates training on walking, balance, fall risk, respiratory, and cognitive functions in persons with multiple sclerosis: A randomized controlled trial. *Explore*. 2020; 16:12-20.
 27. Alaca N. The relationships between pain beliefs and kinesiophobia and clinical parameters in Turkish patients with chronic knee osteoarthritis: a cross-sectional study. *J Pak Med Assoc*. 2019; 69:823-7.
 28. Akodu AK, Fapojuwo OA, Quadri AA. Comparative effects of Pilates and isometric exercises on pain, functional disability and range of motion in patients with knee osteoarthritis. *Res J Health Sci*. 2017; 5:94-103.
 29. Bird ML, Fell J. Positive long-term effects of pilates exercise on the age-related decline in balance and strength in older, community-dwelling men and women. *J Aging Phys Act*. 2014; 22:342-7.
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