DOI: 10.7860/JCDR/2023/63345.18238

Original Article

Physiotherapy Section

Effect of Home-Based versus Clinic-Based Exercise Training on Balance and Function in the Geriatric Population with Knee Osteoarthritis: A Non Randomised Controlled Trial

CHIRAG JERAM PARMAR[1], TRUPTI KAVIT MUNSHI[2]

ABSTRACT

Introduction: Knee Osteoarthritis (OA) affects 30-40% of the population worldwide by the age of 65 years and is associated with proprioception loss, postural instability, and fall risk. Strengthening and balance exercises at home can prevent these issues. The Otago home exercise program is commonly used for fall prevention in the elderly.

Aim: To compare the effects of home-based and clinic-based exercise training on balance and function in geriatric individuals with knee OA.

Materials and Methods: A non randomised controlled trial (NRCT) was conducted from October 2017 to December 2017 at an old age home and residential zone of Ahmedabad city. Nineteen participants were divided into two groups: group A (home-based exercise) with nine participants, and group B (clinic-based exercise) with ten participants. The exercises were based on the Otago program. The study duration was eight weeks, and outcome measures included the Berg Balance Scale (BBS) for static and dynamic balance, the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) for physical function, the Timed Up and Go (TUG) test for dynamic balance, and the Visual Analog Scale (VAS) for knee pain. Data analysis was performed using Statistical Package for the Social Science (SPSS) version 22.0, employing the Wilcoxon and Mann-Whitney tests for within group and between group comparisons, respectively.

Results: Group A (home-based exercise) showed significant improvements in BBS (p-value=0.007), WOMAC (p-value=0.007), and TUG (p-value=0.027). Group B (clinic-based exercise) also showed significant improvements in BBS (p=0.005), WOMAC (p=0.005), and TUG (p=0.041). When comparing the two groups, significant differences were found in BBS (p=0.013) and WOMAC (p=0.039), but not in TUG (p=0.864) and VAS (p=0.908). The clinic-based exercise group demonstrated greater improvement, as indicated by higher pre and postintervention readings.

Conclusion: This study concludes that both home-based and clinic-based exercises are effective in improving balance and physical function in geriatric individuals with knee OA. However, clinic-based exercise interventions showed greater improvement, as evidenced by higher pre and postintervention readings in the clinic-based exercise group.

Keywords: Musculoskeletal, Rehabilitation, Rheumatology, Visual analog scale

INTRODUCTION

Knee Osteoarthritis (OA) is a prevalent musculoskeletal condition that affects 30-40% of the global population by the age of 65 years [1]. In India, the geriatric population was 8.6% according to the 2011 census and is expected to increase to 19% by 2050 [2]. Knee OA contributes to hospital admissions and fatalities among older adults due to proprioception loss, postural instability, and fall risk. The Otago program, which includes strength and balance training, is widely used to prevent falls in this population. A pilot study by Williams SB et al. investigated the feasibility and outcomes of a home-based exercise program for improving balance and gait stability in women with lower-limb OA or rheumatoid arthritis. The study found that an individualised balance training home exercise program is feasible for older women with OA or rheumatoid arthritis and may enhance stability during walking and other functional activities [3].

Another study by Deyle GD et al. compared the effects of supervised clinical exercise and manual therapy procedures with a home exercise programme. The study revealed that the clinic treatment group showed twice the improvement in pain, stiffness, and function compared to the home exercise group [4]. Previous studies have compared different approaches and Otago programmes to improve function and balance in knee OA, but none have examined the feasibility and effectiveness of unsupervised Otago home-based exercise training compared to supervised Otago clinic-based exercise training in India. Limited access to physiotherapy centers in rural and remote areas of India poses a barrier to daily treatment for patients, highlighting the need for alternative solutions [5-8]. Therefore, this study aims to evaluate the effect of home-based versus clinic-based exercise on balance and function in geriatric knee OA, assessing the feasibility and effectiveness of both programmes.

MATERIALS AND METHODS

This non randomised controlled trial study was conducted on geriatric individuals aged 65 years and above with knee OA. Ethical approval was obtained from the Ahmedabad Institute of Medical Sciences Institutional Ethics Committee (AIMS/2016/80). The study duration was eight weeks, and subjects were selected from an old age home and residential zone of Ahmedabad city between October 2017 and December 2017. Simple convenient sampling was used, and a sample size of nine per group was determined based on pilot study data, with a Standard Deviation of 2.72, power of 80%, and a clinically significant difference of 3.66.

Inclusion criteria

1. Age 65 years and above.
2. Diagnosis of knee OA based on clinical classification criteria by the American College of Rheumatology (ACR) [9]. This criterion includes subjects over 50 years of age, experiencing crepitus during active motion, having less than 30 minutes of morning stiffness, exhibiting bony tenderness and overgrowth, and the absence of palpable warmth in the synovium.
3. Participants with knee OA reported mild to moderate pain on VAS. Both males and females with knee OA were included in the study. Patients capable of understanding, following commands and expressing willingness to participate were enrolled.

Exclusion criteria

1. Individuals who had suffered from sports injuries or traumatic knee conditions were excluded.
2. Patients diagnosed with inflammatory arthritis, metabolic disorders, or other associated cardiovascular, neurological, and musculoskeletal disorders were excluded. Patients who were obese or had any other systemic disorders were also excluded.

Outcome measures: The Berg Balance Scale (BBS) was used to assess the patient's ability to safely balance during a series of 14 static and dynamic tasks, with a score ranging from 0 to 56 [10]. The Western Ontario and McMaster Universities Arthritis Index (WOMAC) CRD Pune version, validated against the original WOMAC, was used to evaluate pain, stiffness, and function specific to Indian-Asian community conditions [11]. The Timed Up and Go (TUG) test was used to measure dynamic balance and mobility. Timing with a stopwatch begins when the patient is instructed to "go" and ends when the patient returns to the start position in a chair. Most adults can complete the test in less than 10 seconds, and scores over 30 seconds indicate impaired functional mobility [12]. The Visual Analog Scale (VAS) is a self-assessment scale that utilises a 10 cm line divided into 10 equal sections, with 0 representing "no pain" and 10 representing "worst imaginable pain". VAS is widely used due to its simplicity and adaptability to a broad range of populations and settings [13].

Procedure

Prior to the study, informed consent was taken from all the participants. Out of 28 screened patients, 19 were selected for the study, including 11 females and eight males, all of them had knee OA and balance impairment. Nine (47.4%) participants were assigned to group A for home-based exercise training, and 10 (52.6%) participants were assigned to group B for clinic-based exercise training based on their preference. The participants were then evaluated using outcome measures.

Group A (home-based exercise training) participants received an Otago exercise figure chart illustrating all exercises, an exercise prescription chart to record the number of repetitions, and a calendar to track exercise days. The Otago exercises included flexibility, strengthening, and balance retraining exercises. The level and number of repetitions for the strengthening and balance retraining exercises were referenced from the Otago home exercise program [14]. Specific exercises for flexibility, strengthening, and balance were assigned to the participants [Table/Fig-1-16]. Participants were instructed and supervised until they achieved satisfactory performance. They were then instructed to perform all exercises four days per week and engage in outdoor walking for 30 minutes two days per week, with Sunday designated as a rest day. Weekly visits were conducted to reassess performance and adjust the difficulty levels of exercises.

Group B (clinic-based exercise training) participants received the same materials as group A, but had a physiotherapist supervising their exercises daily in the Physiotherapy Department of an old age home.

At the end of eight weeks, all participants from both groups were reassessed using outcome measures.

STATISTICAL ANALYSIS

Statistical Package for Social Sciences (SPSS) version 22.0 was employed for statistical analysis. The level of significance for the entire statistical analysis was set at 5%. The Wilcoxon test was used for intragroup comparisons, and the Mann-Whitney test was applied for intergroup comparisons.

RESULTS

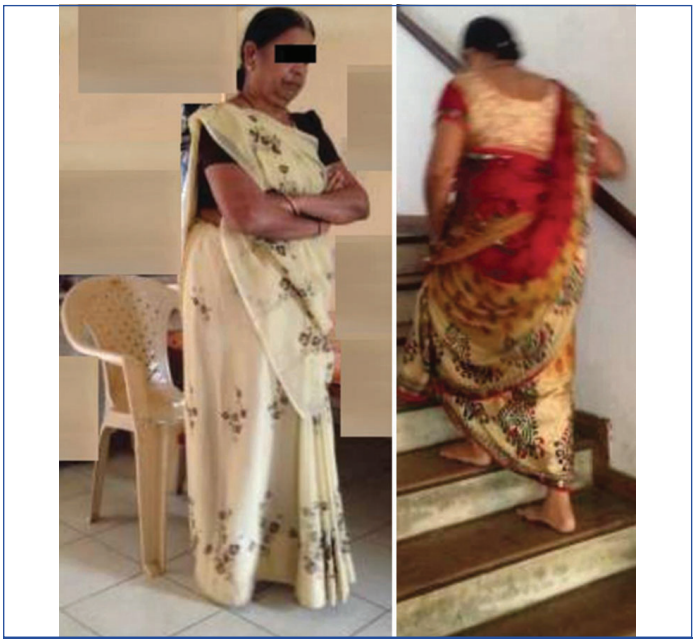
For intragroup comparison [Table/Fig-17], there was a significant difference in BBS between the group A and group B (p-value=0.007 and 0.005, respectively). There was also a significant difference in pre- and postintervention WOMAC scores in both the group A and the group B (p-value=0.007 and 0.005, respectively). Additionally, there was a significant difference in pre- and postintervention TUG scores in both the group A and the group B (p-value=0.027 and 0.041, respectively). However, no significant difference was observed in VAS scores in either group A or group B (p-value=0.157).

The comparison between groups [Table/Fig-18] aimed to evaluate the differences or similarities between the two distinct groups (group A and group B). A significant difference was found in BBS scores between the home-based group and the clinic-based group (p-value=0.013). There was also a significant difference in WOMAC scores between group A and group B (p-value=0.039). However, no significant difference was observed in TUG and VAS scores (p-value=0.864 and 0.908, respectively).

[Table/Fig-1]: Back extension. **[Table/Fig-2]:** Front knee strengthening exercise. **[Table/Fig-3]:** Back knee strengthening (starting position). **[Table/Fig-4]:** Back knee strengthening (ending position). (Images from left to right)

[Table/Fig-5]: Side hip strengthening (starting position). **[Table/Fig-6]:** Side hip strengthening (ending position). **[Table/Fig-7]:** Calf raise. **[Table/Fig-8]**: Toe raise. **[Table/Fig-9]:** Walking backwards exercise. (Images from left to right)

[Table/Fig-10]: Walk and turn (figure of 8 pattern)-Walking. **[Table/Fig-11]:** Walk and turn (figure of 8 pattern)-turning. **[Table/Fig-12]:** Heel toe walk. **[Table/Fig-13]:** Heel to toe walking backwards approach. **[Table/Fig-14]:** Sit to stand approach (starting position). (Images from left to right)



[Table/Fig-15]: Sit to stand approach (ending position).
[Table/Fig-16]: Walking on stairs approach. (Images from left to right)

Group		Mean	Wilcoxon test	p-value
Group A	BBS prereading	41.22	2.677	0.007
	BBS prereading	45.67		
	WOMAC prereading	39.67	2.677	0.007
	WOMAC prereading	29.00		
	TUG prereading	15.78	2.214	0.027
	TUG prereading	14.33		
	VAS prereading	1.00	1.414	0.157
	VAS prereading	0.78		
Group B	BBS prereading	38.70	2.807	0.005
	BBS prereading	46.80		
	WOMAC prereading	37.20	2.805	0.005
	WOMAC prereading	22.40		
	TUG prereading	14.30	2.041	0.041
	TUG prereading	12.90		
	VAS prereading	1.00	1.414	0.157
	VAS prereading	0.80		

[Table/Fig-17]: Intragroup comparison of both training methods.
Wilcoxon Test* (group A Home-based, group B- Clinic-based); p-value <0.05 considered significant

Groups	N	Mean rank	Mann-Whitney test	p-value
dBBS				
Group A	9	6.67	15	0.013
Group B	10	13.00		
Total	19			
dWOMAC				
Group A	9	7.22	20	0.039
Group B	10	12.50		
Total	19			
dTUG				
Group A	9	10.22	43	0.864
Group B	10	9.80		
Total	19			
dVAS				
Group A	9	10.11	44	0.908
Group B	10	9.90		
Total	19			

[Table/Fig-18]: Intergroup comparison of both training methods.
Mann-Whitney Test*
(Group A=Home-based group, Group B=Clinic-based group)
dBBS=difference between groups for BBS, dWOMAC=difference between groups for WOMAC
dVAS=difference between groups for VAS, dTUG=difference between groups for TUG;
p-value <0.05 considered significant

Since the difference between prereading and prereading in the clinic-based group was greater compared to the home-based group, clinic-based exercise was found to show more improvement.

DISCUSSION

The BBS scores in group A and group B showed improvement (p-value=0.007 and 0.005, respectively) because the training focused on lower limb strengthening, postural correction exercises, and balance retraining. The improvement in balance can be attributed to functional tasks such as sit to stand [Table/Fig-14,15], backwards walk [Table/Fig-9], walk and turn [Table/Fig-10,11], heel toe walk [Table/Fig-12,13], calf raises and toe raises [Table/Fig-7,8], and stairs walking [Table/Fig-16]. This finding is supported by a study conducted by Goel A et al., which found that participants who received strength and balance training showed greater improvement compared to those who only received strength training [6].

There was a significant difference in WOMAC scores between the group A and group B (p-value=0.007 and 0.005, respectively). The improvement in physical function can be attributed to exercises such as front knee strengthening, back knee strengthening, side hip strengthening, calf raises, and toe raises. Additionally, posture correction exercises like head movements, neck movements, back extension, trunk movements, and ankle movements were emphasised, which facilitated physical function. A comparative study by Deyle GD et al., between clinic-based and home-based physical therapy programmes in knee OA subjects found that after four weeks of training, the group B showed a 52% improvement in WOMAC scores, while the group A showed a 26% improvement. However, after one year of training, both groups showed substantial and equal improvements over baseline measurements [4]. Another study by O'Reilly SC et al., examined the effectiveness of home exercise on pain and disability from knee OA through a randomised controlled trial. The exercises included isotonic quadriceps contraction in mid-flexion, isotonic hamstring contraction, isotonic quadriceps contraction with a resistance band, and dynamic stepping exercises. After six months, they found that the WOMAC pain score was reduced by 22.5% in the exercise group and 6.2% in the control group. Therefore, a simple program of home quadriceps exercises can significantly improve self-reported knee pain and physical function as assessed by the WOMAC score [15].

According to a research report by Shumway-Cook A et al., a cutoff level of 13.5 seconds or longer in the TUG test has an overall correct prediction rate of 90% for increased risk of falls. Subjects who take more than 13.5 seconds to complete the TUG test are believed to have an increased risk of falls [16]. Almost half of the participants, 10 out of 19, showed TUG test results of more than 13.5 seconds, indicating potential increased risk of falls. During gait training, patients were instructed to walk daily for 30 minutes at their own pace and stability, which may explain why there was not a significant improvement in walking speed. However, a meta-analysis conducted by Tanaka R et al., found that exercise therapy can improve the amount of time spent walking, gait velocity, and possibly the total distance walked [17].

During this study, participants experienced mild to moderate knee pain. Warm water application was advised at home for pain management. In a study conducted by Denegar CR et al., in 2010, it was found that warm water applied for 15 minutes twice daily resulted in self-determined maximal comfort for patients and a significant reduction in knee OA pain as measured by the VAS [18].

The outcomes observed in the home-based group, despite showing improvement, may be attributed to suboptimal adherence to the prescribed intervention protocol. According to Argent R et al., lower adherence or non adherence to home exercise rehabilitation in musculoskeletal populations can be influenced by factors such as patients' beliefs, self-efficacy with the exercise task, depression status, and perceived barriers like forgetting to exercise [19]. Future recommendations include the concept of connected health interventions, which involve a combination of supervision, feedback, and reinforcement. Physiotherapists should provide positive feedback, monitor performance and progression closely, and aim to enhance adherence. In developed countries, tele-rehabilitation through video conferencing or video calling has been effective [19]. However, in rural or remote areas of India where internet technology may be limited, daily phone calls could be considered as an effective measure to keep patients motivated. Providing daily task appreciation through telephonic communication, along with weekly in-person visits, has the potential to enhance patient adherence.

Limitation(s)

The results should be interpreted with caution due to the limited duration of the study, which was only eight weeks. Long-term studies are needed to confirm these findings and document changes.

CONCLUSION(S)

This study concludes that both home-based and clinic-based exercises were effective in improving balance and physical function in the geriatric population with knee OA. However, the clinic-based exercise intervention was found to be better, as the preintervention and postintervention readings were higher in the clinic-based exercise training group. The lower level of adherence in the home-based group may be a possible reason for this difference, which could potentially be overcome by maintaining communication via tele-rehabilitation to enhance patient engagement. Further research is needed to explore the feasibility and effectiveness of this intervention.

Acknowledgement

On this pleasant occasion, I would like to express my heartfelt gratitude to God for giving me the strength to carry out this work. I sincerely thank my family for their cooperation and support. I am grateful to all the subjects for their kind cooperation and willingness to participate in this study, without whom this study would not have been possible.

REFERENCES

[1] Van Saase JLCM, Van Romunde LKJ, Cats A, Vandebroucke JP, Valkenburg HA. Epidemiology of osteoarthritis: Zoetermeer survey. Comparison of radiological osteoarthritis in a Dutch population with that in 10 other populations. Annals of the Rheumatic Diseases. 1980;48(4):271-280.

[2] Khan S, Itrat M. Current issues in geriatric health care in India-A review. Journal of Community Medicine and Health Care. 2016;1(1):1003.
[3] Williams SB, Brand CA, Hill KD, Hunt SB, Moran H. Feasibility and outcomes of a home-based exercise program on improving balance and gait stability in women with lower-limb osteoarthritis or rheumatoid arthritis: A pilot study. Archives of Physical Medicine and Rehabilitation. 2009;91(1):106-114. Doi: 10.1016/j.apmr.2009.08.150.
[4] Deyle GD, Allison SC, Matekel RL, Ryder MG, Stang JM, Gohdes DD, et al. Physical therapy treatment effectiveness for osteoarthritis of the knee: A Randomised comparison of supervised clinical exercise and manual therapy procedures versus a home exercise program. Physical Therapy. 2005;85(12):1301-17.
[5] Son NK, Ryu YU, Jeong HW, Jang YH, Kim HD. Comparison of 2 different exercise approaches: Tai Chi Versus Otago, in community-dwelling older women. Journal of Geriatric Physical Therapy. 2016;39(2):51-57.
[6] Goel A, Agrawal S, Verma M. Effect of balance exercises on balance, pain, and functional performance in osteoarthritis knee. Indian Journal of Physical Therapy. 2014;2(1):71-78.
[7] Liu-Ambrose T, Donaldson MG, Ahamed Y, Graf P, Cook WL, Close J, et al. Otago home-based strength and balance retraining improves executive functioning in older fallers: A randomised controlled trial. Journal of the American Geriatrics Society. 2008;56(10):1821-30. Doi: 10.1111/j.1532-5415.2008.01931.x.
[8] Patel MNN, Pachpute DS. The effects of Otago exercise programme for fall prevention in elderly people. International Journal of Physiotherapy. 2015;2(4):633-39.
[9] Altmann R, Asch E, Bloch D, G Bole, Borenstein D, Brandt K, et al. Development of criteria for the classification and reporting of osteoarthritis. Classification of osteoarthritis of the knee. Diagnostic and Therapeutic Criteria Committee of the American Rheumatism Association. Arthritis and Rheumatism.1986;29(8):1039-49.
[10] Takacs J, Garland SJ, Carpenter MG, Hunt MA. Validity and reliability of the community balance and mobility scale in individuals with knee osteoarthritis. Physical Therapy. 2014;94(6):866-74.
[11] Chopra A, Lavin P, Patwardhan B, Chitre D. Practical report on rheumatic and musculoskeletal diseases. Journal of Clinical Rheumatology. 2004;10:236-45.
[12] Alghadir A, Anwer S, Brismée JM. The reliability and minimal detectable change of the Timed Up and Go test in individuals with grade 1-3 knee osteoarthritis. BMC Musculoskeletal Disorders. 2015;16:174. Doi: 10.1186/s12891-015-0637-8.
[13] Alghadir AH, Anwer S, Iqbal A, Iqbal ZA. Test-retest reliability, validity, and minimum detectable change of visual analog, numerical rating, and verbal rating scales for measurement of osteoarthritic knee pain. Journal of Pain Research. 2018;26;11:851-56.
[14] Otago Medical School, University of Otago. Otago Exercise Programme to prevent falls in older adults, a home-based, individual-tailored strength and balance retraining programme. 2003. Available at: https://www.livestronger.org.nz/assets/Uploads/acc1162-otago-exercise-manual.pdf.
[15] O'Reilly SC, Muir KR, Doherty M. Effectiveness of home exercise on pain and disability from osteoarthritis of the knee: A randomised controlled trial. Annals of the Rheumatic Diseases. 1999;58(1):15-19. Doi: 10.1136/ard.58.1.15.
[16] Shumway-Cook A, Brauer S, Woollacott M. Predicting the probability for falls in community-dwelling older adults using the timed up & go test. Physical Therapy. 2000;80(9):896-903.
[17] Tanaka R, Ozawa J, Kito N, Moriyama H. Effects of exercise therapy on walking ability in individuals with knee osteoarthritis: A systematic review and meta-analysis of randomised controlled trials. Clinical Rehabilitation. 2016;30(1):36-52.
[18] Denegar CR, Dougherty DR, Friedman JE. Preferences for heat, cold, or contrast in patients with knee osteoarthritis affect treatment response. Clinical Interventions in Aging. 2010;5:199-206.
[19] Argent R, Daly A, Caulfield B. Patient involvement with home-based exercise programs: Can connected health interventions influence adherence? JMIR mHealth and uHealth. 2018;6(3):e47. Doi: 10.2196/mhealth.8518.

PARTICULARS OF CONTRIBUTORS:
1. Lecturer, Department of Community Health and Rehabilitation, Ahmedabad Institute of Medical Sciences, Ahmedabad, Gujarat, India.
2. Physiotherapist, Department of Rehabilitation, Swasthya Physiotherapy and Health Clinic, Ahmedabad, Gujarat, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Chirag Jeram Parmar,
19, Devanshi Apartment, Behind Shraddha High School, Jodhpur Village Road, Satellite, Ahmedabad-380015, Gujarat, India.
E-mail: chiragj81@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Feb 18, 2023
- Manual Googling: May 23, 2023
- iThenticate Software: Jun 21, 2023 (14%)

ETYMOLOGY: Author Origin

EMENDATIONS: 6

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Feb 10, 2023**
Date of Peer Review: **Apr 08, 2023**
Date of Acceptance: **Jun 29, 2023**
Date of Publishing: **Jul 01, 2023**