Journal of Pioneering Medical Sciences
Received: January 15, 2025 | Accepted: February 26, 2025 | Published: April 27, 2025
Volume 14, Issue S01, Pages 414-416

DOI https://doi.org/10.47310/jpms202514S0154

Adherence of an Exercise Protocol on Balance and Lower Extremity Function in Postmenopausal Women With Osteoarthritic Knee Joint: A Comparative Study

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Abstract **Objective:** The research examined postmenopausal women with osteoarthritic (OA) knee joints to understand their exercise adherence rate for an 8-week period as well as its impact on their balance and lower extremity function. **Methods:** Two groups of thirty participants received random assignment which placed half into Group A stable surface exercises and half into Group B unstable surface exercises. The research included Knee Injury and Osteoarthritis Outcome Score (KOOS) and Timed Up and Go (TUG) test assessments before and after the intervention period. A logbook and self-report questionnaire were used to monitor both adherences and feasibility levels. **Results:** The subjects in both exercise groups showed significant improvements in KOOS scores (Group A: 65.9±6.39 to 75.4±4.14; Group B: 58.1±3.91 to 64.3±4.83) yet participants in Group A achieved a larger improvement of 14.4% compared to Group B's improvement rate of 10.7%. The scores for TUG improved significantly in both groups ($p<0.001$) and showed no statistically important difference between the groups ($p = 0.535$). A high number of 82.5% patients experienced exercise tolerance through participation in the program. **Conclusion:** Postmenopausal women with OA underwent an 8-week exercise protocol that produced meaningful improvements in both balance abilities and lower limb functionalities. The improvements from stable surface training practices (Group A) exceeded those of unstable surface exercises which provides valuable knowledge for physiotherapy treatment protocols.

Key Words Feasibility, Knee joint, Osteoarthritis, Physical activity, Postmenopausal women

INTRODUCTION

Osteoarthritis (OA) creates disability problems among older individuals with special effects on postmenopausal female patients because of hormonal transitions and bone toxicity alongside muscle weakness. Such limitations of knee OA cause joint mobility restriction alongside muscle dysfunctions while affecting balance ability which finally heightens fall threat and degrades life quality [1]. Exercise serves as a vital component in OA management since it helps reduce pain levels while it improves both functionality and delays disease worsening [2]. Strong evidence exists regarding exercise use for OA treatment yet patients fail to follow recommended exercises especially those who belong to older age groups [3].

The Knee Injury and Osteoarthritis Outcome Score (KOOS) [4] and Timed Up and Go (TUG) test [5] represent standard measures to evaluate function in individuals with OA. The KOOS delivers complete examinations for pain combined with daily tasks and life quality measurements but TUG evaluates functional mobility as a crucial indicator for fall risks.

The research determines whether postmenopausal women with chronic knee osteoarthritis would benefit from an 8-week exercise program conducted on stable or unstable surfaces regarding balance and lower extremity function improvement. The research design features surface type comparison because unstable surfaces optimize neuromuscular coordination while stable surfaces enable safer strength training environments. Research shows both surface types have the ability to alter functional results yet no definitive valid study exists comparing their effects. The time period of 8 weeks was chosen from existing research which shows it delivers quantifiable improvements to musculoskeletal recovery during rehab protocols [6].

Objectives

- To assess the adherence and feasibility of an 8-week exercise protocol in postmenopausal women with knee OA
- To compare the effectiveness of exercises performed on stable versus unstable surfaces on balance and lower limb function
- Hypothesis: Stable surface exercise (Group A) will result in greater improvements in KOOS and TUG scores than unstable surface exercise (Group B)
- Primary outcome: Improvement in balance and lower extremity function (KOOS, TUG)
- Secondary outcome: Participant adherence and acceptability of the exercise protocol

MATERIALS AND METHODS

The randomized study took place at the Cooperative Institute of Health Sciences in Kerala India as its location. The Institutional Ethics Committee gave their approval for both participants and researchers which allowed written consent acquisition before study enrollment.

Thirty postmenopausal women aged 50-65 years were chosen for this study because they had unilateral knee OA (Grade II-III) according to Kellgren-Lawrence criteria to form two research groups by using computerized random selection. This research eliminated patients who showed signs of secondarily-derived osteoarthritis and those with ligament damage in addition to those who had undergone recent surgery or had BMI levels higher than 30. The study excluded patients who had systemic health conditions or any conditions that affected their balance or mobility abilities.

Group A exercise participants worked on stable platforms yet Group B members participated on balance boards and trampolines that provided unsteady surfaces. The participants completed a structured intervention after their 15-minute IFT session that included a 45-minute program of warm-up followed by retro walking and joint loading activities. The physical exercise procedures were supervised by trained physiotherapists who asked participants to record their exercise participation details in logbooks.

Laboratory staff performed outcomes assessments while being made aware of the different groups but they did not gain knowledge regarding participant allocations to minimize observer prejudice.

Statistical Analysis

The IBM SPSS 21.0 (IBM Corp., Armonk, NY, USA) was used for statistical analysis. Within and across groups were compared using student-paired and unpaired t-tests. The significance level was set at $p \leq 0.05$.

RESULTS

The mean age was 55.27±1.49 in group A and 57.13±1.89 in group B. There were no major adverse effects and strong adherence with 4 drop-outs were recorded.

The self-reported questionnaire revealed that almost one out of every five sessions resulted in considerable pain, which often recovered quickly. Following the eight-week intervention period, the intervention groups demonstrated significant improvements in leg function and balance. In our questionnaire, 82.5% of participants stated their exercise sessions were "appropriate," with 15.6% revealing that they were "too long." In terms of the difficulty of carrying out the exercises, 66.2% believed they were "appropriate." 15% said "Some exercises are difficult to perform" and 16.4% stated, "All exercises are difficult to perform." The level of supervision was judged "just right" by all patients. Concerning the negative consequences of the training session, 15% said that they were present.82.9% stated that the effects of exercise sessions on muscle strength were "not there." 66.7% reported increased lower extremity strength, 60.2% claimed improved balance, and 65.8% reported more flexibility. The final item on the questionnaire covered the progress observed in daily activities. 58.3% indicated an increase in sitting-to-standing habits. 66.1% reported an improvement in stairclimbing, 61.4% in squatting motion, 82.8% in walking, and 62.6% reported less pain while standing for an extended duration. Group A (mean age: 55.27±1.49) and Group B (mean age: 57.13±1.89) showed no baseline differences. KOOS scores improved significantly in both groups ($p<0.001$), with greater gains in Group A (14.4%) compared to Group B (10.7%). TUG test scores also improved significantly within both groups ($p = 0.000$); however, between-group differences were not statistically significant ($p = 0.535$). Adherence data showed high feasibility, with 82.5% of participants reporting the program as appropriate. Minor discomfort was reported in some sessions but resolved quickly. Participants noted improvements in muscle strength, flexibility, and activities like walking, stair climbing, and squatting.

Within groups, KOOS comparisons in Groups A and B yielded significant results ($p<0.001$). The pre-test and post-test comparisons between Groups A and B revealed significant differences ($p<0.001$). Group A exhibited a 14.4% improvement, while Group B showed a 10.7% improvement ($p<0.001$). Within-group TUG scale comparisons in Groups A and B yielded significant results ($p = 0.000$). The pre-test and post-test comparisons of groups A and B were insignificant ($p>0.05$). Groups A and B decreased by 14.6% and 15.3%, respectively ($p = 0.535$) (Table 1).

DISCUSSION

The research shows that postmenopausal women with knee OA experience important functional and balance improvements through an 8-week exercise program. Supervised physiotherapy programs show good acceptability among this patient population since adherence reached 73.3% and withdrawal rates remained low.

Table 1: Effect of exercise protocol on balance and lower extremity function

	Group A		t-test	p-value	Group B		t-test	p-value
	Pre-test	Post-test			Pre-test	Post-test		
TUG test	15.8±1.61	13.5±1.55	3.99	0.0004**	15.7±1.29	13.3±1.31	5.06	0.000**
Group A vs. Group B (pre-test)			-0.19	0.85				
Group A vs. Group B (post-test)			0.38	0.71				
KOOS	65.9±6.39	75.4±4.14	4.83	0.000**	58.1±3.91	64.3±4.83	-3.86	0.000**
Group A vs. Group B (pre-test)			-4.03	0.000**				
Group A vs. Group B (post-test)			6.76	0.000**				

p<0.01-highly significant; p>0.05-statistically insignificant

The stable surface condition in Group A led patients to experience better score outcomes from KOOS indicating that stable surfaces allow participants to feel confident through movements while adapting their strength capacities. The complicated challenges provided by unstable surfaces likely caused Group B participants to show hesitation about falling so they restricted their movement range [7].

The study's TUG test failed to show any significant difference between groups after intervention due to both groups succeeding in performing the structured loading activities [8,9]. Our research findings demonstrate the same outcomes observed by current research which supports the use of surface-based treatments for managing OA. Research about surface stability comparisons remains limited with only few studies existing which makes our current findings hold major clinical value. Exercise proves to be a sustainable low-cost approach for delaying OA progression together with enhancing mobility while reducing pain [10-12]. Future research should test the psychological effects of exercise and evaluate how exercise-use with nutritional and pharmacological interventions could create enhanced benefits.

The bone responds to variations in habitual mechanical loading. Henceforth, exercises are the key technique to increase bone mass at any stage of life. Thus in this investigation joint-loading or weight-bearing exercises and contrasting against the stable and unstable surfaces. It was observed that these kinds of exercises impact the weaker bones of postmenopausal women. Therefore, the study used low-cost, time-efficient exercise programs that target specific muscle groups to improve physical function, and functional mobility in the study population.

CONCLUSIONS

Postmenopausal women with knee OA benefited from an 8-week supervised exercise program which maintained safety standards and gained high patient acceptance while enhancing both their balance capabilities and lower extremity functioning. The individuals who trained on stable surfaces achieved better results than those who used unstable surfaces. Physiotherapists should use stable surface training as their primary intervention protocol to treat knee OA patients while adapting programs to each person's joint condition and balance abilities.

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