ORIGINAL RESEARCH PAPER
Volume - 14 | Issue - 10 | October - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

EFFECT OF CLOSED KINEMATIC CHAIN EXERCISES ON PAIN, BALANCE AND QUALITY OF LIFE AMONG GERIATRIC POPULATION WITH KNEE OSTEOARTHRITIS

Physiotherapy

S. Naveen Kumar* BPT Interns, College of Physiotherapy, SVIMS, Tirupati. *Corresponding Author
E. Kamalakar BPT Interns, College of Physiotherapy, SVIMS, Tirupati.
R. Harish Kasyap BPT Interns, College of Physiotherapy, SVIMS, Tirupati.
Dr. V. Sri Kumari MPT(Neurology), PhD Associate Professor, College of Physiotherapy, SVIMS, Tirupati.
Dr. K. Madhavi MPT (Cardiovascular & Pulmonary), PhD Professor & Principal, College of Physiotherapy, SVIMS, Tirupati.

ABSTRACT

Background: Osteoarthritis (OA) is one of the leading causes of disability among elderly individuals worldwide. Closed kinematic chain (CKC) exercises are functional, safe, and cost-effective rehabilitation strategies that may reduce pain and improve functional performance. **Objective:** To evaluate the effects of CKC exercises on pain, balance, and quality of life in elderly individuals with knee OA. **Methods:** A quasi-experimental study was conducted on 81 elderly residents in Tirupati. Thirty-one with clinically significant knee OA (WOMAC scale) were recruited. Pain (VAS), balance (Single-Leg Stance), and quality of life (SF-36) were measured before and after a 3-week CKC program including squats, leg presses, pelvic bridging, and step-ups. Data were analysed using SPSS v22.0. **Results:** Post-intervention, VAS pain scores decreased significantly ($p<0.001$), balance improved ($p=0.016$), and SF-36 scores improved ($p<0.001$). **Conclusion:** CKC exercises significantly improve pain, balance, and quality of life in geriatric patients with knee OA. They are recommended as a non-pharmacological management strategy.

KEYWORDS

Osteoarthritis, closed kinematic chain, WOMAC, pain, balance, quality of life.

INTRODUCTION

Osteoarthritis (OA) is a progressive degenerative joint disease characterized by loss of articular cartilage, pain, stiffness, and functional decline. It is the most common form of arthritis in older adults and a leading cause of lower-limb disability worldwide [1&2]. The knee joint is particularly vulnerable due to weight-bearing and repetitive stress during daily activities [3].

Globally, the prevalence of OA is increasing with aging populations. In India, estimates suggest that 22–39% of elderly individuals are affected [4], with higher prevalence in women and rural populations. Lifestyle factors such as squatting, sitting cross-legged, barefoot walking, and heavy physical labour contribute to early onset and progression [5&6]. Obesity is the strongest modifiable risk factor for OA [7].

Conventional treatment includes pharmacological agents and surgery, but these approaches may not be feasible for all elderly individuals due to comorbidities and costs. Non-pharmacological interventions, particularly exercise therapy, remain essential. Closed kinematic chain (CKC) exercises involve weight-bearing movements with distal segments fixed (e.g., squats, step-ups). They mimic functional activities, enhance proprioception, strengthen periarticular muscles, and improve joint stability [8].

While CKC has shown benefits in younger populations and post-surgical rehabilitation, limited evidence exists on its impact in elderly OA patients. This study investigates the role of CKC in reducing pain, improving balance, and enhancing quality of life in geriatric individuals with knee OA.

MATERIALS AND METHODS

Study Design And Setting

This quasi-experimental study was conducted at Padmavati Old-Age Home, Tirupati, from July to August 2025.

Participants

A total of 81 elderly residents (>60 years) were screened using the WOMAC scale. Thirty-one participants with clinically significant knee OA and knee pain were recruited.

Inclusion Criteria:

- Age >60 years
- Both genders
- Knee pain with WOMAC scores indicating moderate-to-high risk

Exclusion Criteria:

- Severe illness or bedridden state
- Neurological conditions (e.g., Parkinson's, DMD)
- Recent knee surgeries or fractures
- Uncontrolled hypertension, cardiac disease, or severe osteoporosis

Intervention Protocol

Participants underwent a 3-week supervised CKC exercise program, performed 3 times per week. Each session included:

- **Squats:** 3–5 sets, 5–7 reps, progressive intensity
- **Leg press:** 3–5 sets, hold 3–5 seconds
- **Pelvic bridging:** 3 sets, 5 reps, hold 5 seconds
- **Step-ups:** 10 steps per set

Exercises progressed gradually to improve tolerance and effectiveness.

Type of exercise	Intensity	Frequency	Duration
SQUATS	Mild intensity	3 sets, 5 repetitions/set	3 weeks
	Moderate intensity	5 sets, 7 repetitions/set	
LEG PRESS	Mild intensity	3 sets, 5repetitions/set and hold for 3 seconds	3 weeks
	Moderate intensity	5 sets, 7 repetitions/set and hold for 5 seconds	
PELVIC BRIDGING	Intensity	3 sets, 5 repetitions/set and hold for 5 seconds	3 weeks
STEP-UPS	Intensity	10 steps/set	3 weeks

Outcome Measures

- **WOMAC scale:** Pain, stiffness, and function (baseline only).
- **VAS scale:** Pain intensity (0–10).
- **Single-Leg Stance Test:** Balance (in seconds).
- **SF-36 Questionnaire:** Quality of life.

Data Analysis

Data were analysed using SPSS v22.0. Paired t-tests compared pre- and post-intervention values. Associations between risk factors and WOMAC scores were tested with chi-square. $p<0.05$ was considered significant.

RESULTS

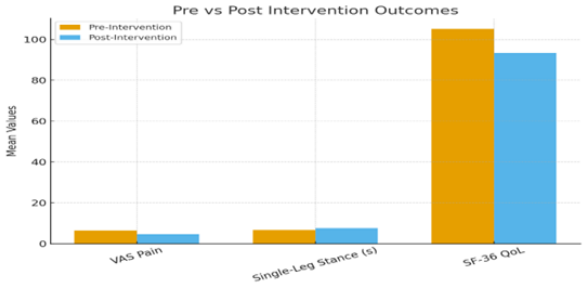
Demographics

- Mean age: 74.8 ± 11.5 years (range 60–95).
- Gender: 55.6% female, 44.4% male.
- BMI: 56.8% overweight, 23.5% normal, 19.8% underweight.
- Trauma history: 54.3%.
- Previous surgery: 56.8%.
- Family history of OA: 55.6%.

WOMAC Classification
- High risk: 45.7%
- Moderate risk: 43.2%
- Low risk: 11.1%

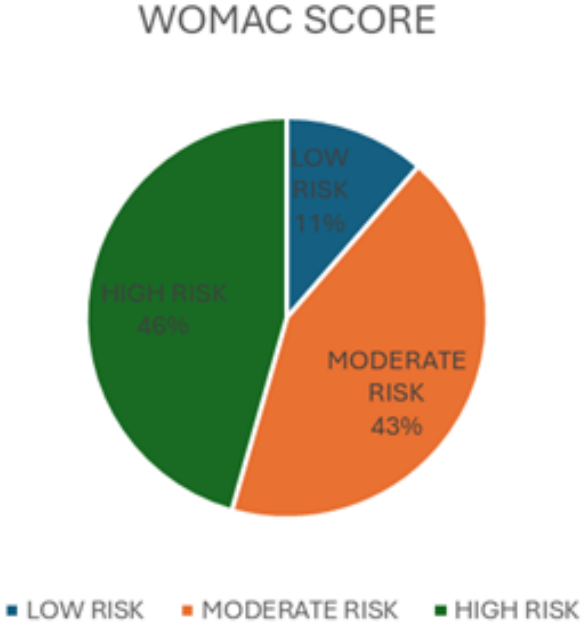
BMI, trauma history, and surgery were significantly associated with high WOMAC scores ($p<0.05$). Gender and family history showed no significant associations.

Pain (VAS)
- Pre: 6.42 ± 1.77
- Post: 4.71 ± 1.90
- Improvement**:** -1.71 ($p<0.001$)



Balance (Single-Leg Stance)
- Pre: 6.68 ± 2.52 sec
- Post: 7.61 ± 1.89 sec
- Improvement**:** +0.94 sec ($p=0.016$)

Quality of Life (SF-36)
- Pre: 105.1 ± 9.25
- Post: 93.3 ± 8.24
- Improvement**:** +11.8 points ($p<0.001$)



DISCUSSION

This study demonstrates that CKC exercises effectively reduce pain, enhance balance, and improve quality of life in elderly individuals with knee OA.

Pain Reduction

VAS scores decreased significantly after 3 weeks of CKC training. This aligns with prior studies showing CKC enhances quadriceps activation, reduces joint loading, and improves functional performance. Unlike open-chain movements, CKC distributes forces across multiple joints, reducing stress on the knee.

Balance Improvement

Balance, as measured by the single-leg stance test, improved significantly. Enhanced proprioception and neuromuscular control likely contributed to this improvement. CKC exercises stimulate joint mechanoreceptors, which play a role in postural control.

Quality of Life

Improved SF-36 scores highlight the broader impact of CKC on daily living and independence. Better pain control and balance translate into greater mobility and confidence, reducing dependence on caregivers.

Risk Factors

The study confirmed known risk factors: obesity, trauma, and prior surgery increase OA severity. These findings reinforce the importance of targeted prevention and early rehabilitation in high-risk populations.

CONCLUSION

Closed kinematic chain exercises are effective in reducing pain, improving balance, and enhancing quality of life in elderly patients with knee OA. Given their functional nature and safety, CKC exercises should be integrated into rehabilitation programs for geriatric populations, particularly in community and institutional settings.

LIMITATIONS

- Small sample size.
- Short study duration.
- Lack of long-term follow-up.

RECOMMENDATIONS

Future studies should involve larger randomized controlled trials, include long-term follow-up, and compare this combined protocol with other physiotherapy techniques to establish stronger evidence.

REFERENCES

1. Kurtaiş Y, et al. Reliability and validity of the ICF comprehensive core set for osteoarthritis. *BMC Musculoskelet Disord*. 2011; 12:255.
2. Rajan SI, et al. Demography of Indian aging, 2001–2051. *J Aging Soc Policy*. 2003; 15:11–30.
3. Fransen M, et al. The epidemiology of osteoarthritis in Asia. *Int J Rheum Dis*. 2011; 14:113–21.
4. Pal CP, et al. Epidemiology of knee osteoarthritis in India. *Indian J Orthop*. 2016; 50:518–22.
5. Heidari B. Knee osteoarthritis prevalence and risk factors. *Caspian J Intern Med*. 2011; 2:205–12.
6. Vincent KR, Vincent HK. Resistance exercise for knee osteoarthritis. *PMR*. 2012;4: S45–52.
7. Walsh NE, Hurley MV. Physiotherapy management of knee OA. *Musculoskeletal Care*. 2009; 7:45–56.
8. Blagojevic M, et al. Risk factors for onset of knee OA in older adults: meta-analysis. *Osteoarthritis Cartilage*. 2010; 18:24–33.