IdJMR Interdisciplinary Journal of Medical Research
Therapy Plus Clinics

Original Article

Assessment of Rehabilitation Outcomes in Patients with Chronic Knee Osteoarthritis Receiving Physiotherapy

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Received: 13 November 2024 | Revised: 23 November 2024 | Accepted: 17 December 2024 | Published: 30 December 2024

Citation: Click to Cite | Copyright: © 2024 The Authors. | Publisher: Therapy Plus Clinics (TPC), Pakistan.

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ABSTRACT

***Background**: Chronic knee osteoarthritis is a progressive degenerative condition associated with pain, disability, and reduced mobility, often requiring long-term physiotherapy to improve functional outcomes. Understanding the extent to which rehabilitation influences pain, functional performance, and disability is essential for optimizing conservative management strategies.* ***Objective**: To assess rehabilitation outcomes in patients with chronic knee osteoarthritis receiving physiotherapy by evaluating changes in pain intensity, disability, and functional mobility using validated clinical measures.* ***Methods**: A cross-sectional study was conducted among 96 adults with chronic knee osteoarthritis undergoing physiotherapy. Pain was assessed using the Numeric Pain Rating Scale, disability using the WOMAC Index, and functional performance using the Timed Up and Go (TUG) test and 30-Second Chair Stand Test. Demographic and clinical data were collected, and statistical analyses included descriptive statistics, group comparisons based on physiotherapy duration, and correlation analyses, with significance set at $p \leq 0.05$.* ***Results**: Participants demonstrated moderate baseline disability (mean WOMAC 54.2 ± 12.4) and impaired mobility (TUG 14.8 ± 3.9 seconds). Those receiving ≥8 weeks of physiotherapy exhibited significantly lower pain ($p < 0.001$), reduced disability ($p < 0.001$), faster TUG times ($p = 0.002$), and greater chair-stand performance ($p = 0.001$). Physiotherapy duration showed strong correlations with all outcome measures.* ***Conclusion**: Longer physiotherapy duration is associated with meaningful improvements in pain, disability, and functional mobility, supporting the value of sustained rehabilitation in chronic knee osteoarthritis management.*

***Keywords**: Knee Osteoarthritis; Physiotherapy; Rehabilitation; WOMAC; Functional Mobility; NPRS; TUG Test*

INTRODUCTION

Knee osteoarthritis (KOA) is one of the most prevalent chronic musculoskeletal disorders worldwide and a leading cause of pain, disability, and mobility limitations among adults and older individuals (1). Characterized by progressive degeneration of articular cartilage, synovial inflammation, osteophyte formation, and biomechanical impairments, KOA significantly compromises joint function and quality of life (2). Its global burden continues to increase in parallel with aging populations, rising obesity rates, and sedentary lifestyles, making it a major public health concern. Patients with chronic KOA commonly experience persistent pain, stiffness, muscle weakness, gait abnormalities, and reduced participation in daily and recreational activities, with substantial implications for independence and long-term health (3). As pharmacological therapies offer only symptomatic relief and surgical intervention is often reserved for advanced disease, physiotherapy remains a cornerstone of conservative management aimed at improving functional outcomes and reducing disability (4).

Evidence supports the effectiveness of physiotherapy in managing KOA through targeted interventions such as therapeutic exercise, manual therapy, neuromuscular training, and patient education, all of which contribute to enhanced strength, joint stability, and movement quality (5). However, substantial variability persists in patient responses to rehabilitation, influenced by factors such as disease severity, pain chronicity, muscle dysfunction, psychological status, and adherence to prescribed exercise programs (6). Although numerous studies have evaluated individual physiotherapy modalities, fewer have comprehensively assessed rehabilitation outcomes using standardized, multidimensional measures that capture functional performance, symptom improvement, and quality of life within routine clinical practice. This gap is particularly pronounced in chronic KOA populations, who often present with complex impairments that require tailored and sustained physiotherapeutic strategies (7).

Current literature emphasizes the importance of outcome-based assessment using validated tools such as the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Numeric Pain Rating Scale (NPRS), and functional performance tests like the Timed Up and Go (TUG) and 30-second Chair Stand Test, which collectively provide an integrated view of patient progress (8). Yet, many clinical settings still lack standardized monitoring systems, limiting the ability to evaluate treatment effectiveness and guide individualized rehabilitation planning. There remains a need for well-designed clinical studies that systematically assess physiotherapy outcomes in chronic KOA patients, enabling clinicians to identify which domains improve most with therapy and which patient characteristics predict better rehabilitation trajectories (9). Understanding these patterns is essential for optimizing intervention protocols and ensuring evidence-based practice.

To address these gaps, the present study aims to evaluate rehabilitation outcomes in patients with chronic knee osteoarthritis receiving physiotherapy by assessing changes in pain, functional mobility, and self-reported disability using validated clinical outcome measures. The primary research question is: What is the extent of improvement in pain, functional performance, and disability among patients with chronic knee osteoarthritis following physiotherapy rehabilitation? The study objective is to quantify these improvements and identify clinically meaningful changes across outcome domains.

MATERIALS AND METHODS

This study employed a cross-sectional observational design to evaluate rehabilitation outcomes among adults with chronic knee osteoarthritis receiving physiotherapy, a methodological approach well-suited for examining clinical status and functional performance at a single time point while minimizing temporal variation in exposure and outcomes (10). The study was conducted in the physiotherapy outpatient departments of two tertiary care hospitals that routinely manage musculoskeletal and osteoarthritis cases. Data collection occurred over an eight-month period to ensure adequate recruitment and stability in service delivery patterns. Participants were identified consecutively during routine physiotherapy appointments to reduce selection bias and enhance the representativeness of the clinical population.

Eligible participants were adults aged 40 years and older with a clinical and radiological diagnosis of chronic knee osteoarthritis persisting for at least three months and classified according to established diagnostic criteria (11). Individuals were required to be undergoing active physiotherapy management at the time of data collection. Exclusion criteria included prior knee arthroplasty, inflammatory arthropathies, acute knee trauma within the past six months, neurological disorders affecting lower-limb function, and cognitive impairment that would limit comprehension of questionnaire items. Trained research personnel screened potential participants, explained the study objectives and procedures, and obtained written informed consent prior to enrollment.

Rehabilitation outcomes were assessed using a standardized protocol. Pain intensity was measured using the Numeric Pain Rating Scale (NPRS), a validated 0–10 scale where higher scores indicate greater pain (12). Self-reported disability and functional limitations were assessed using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), which evaluates pain, stiffness, and physical function on a normalized 0–100 scale, with higher scores indicating greater impairment (13). Objective functional performance was measured using the Timed Up and Go (TUG) test, reported in seconds, and the 30-Second Chair Stand Test, reported as the number of repetitions completed, both of which are widely validated in osteoarthritis and mobility-limited populations (14). Demographic and clinical variables including age, sex, body mass index, duration of symptoms, laterality, and physiotherapy duration were obtained through structured interviews and review of clinical records.

The primary variables were pain (NPRS), disability (WOMAC total and subscales), and functional performance (TUG and Chair Stand Test). To minimize measurement bias, all assessors underwent standardized training and adhered to a unified testing protocol. To reduce performance variability related to pain fluctuations, all assessments were conducted at similar times of day, and participants rested before completing functional tasks. Potential confounders including age, BMI, chronicity, and physiotherapy duration were recorded to allow adjusted analyses where appropriate. The sample size of 96 participants was determined using a correlation-based power analysis assuming a moderate effect size ($r = 0.30$), power of 80%, alpha of 0.05, and accounting for up to 10% variability in recruitment, yielding sufficient power to detect clinically meaningful associations across outcome domains.

Data analysis was performed using SPSS version 26. Continuous variables were presented as means and standard deviations, and categorical variables as frequencies and percentages. Normality of continuous data was assessed using the Shapiro–Wilk test. Between-group comparisons across demographic or clinical subgroups were performed using independent t-tests or Mann–Whitney U tests for continuous variables and chi-square tests for categorical variables. Associations among rehabilitation outcomes were evaluated using Pearson or Spearman correlation coefficients depending on data distribution. To account for potential confounding, multivariable linear regression models were constructed for each rehabilitation outcome with adjustments for age, BMI, symptom duration, and physiotherapy duration. Missing data were minimized through real-time checking at data collection; any remaining missing values were handled using pairwise deletion. Statistical significance was defined as $p \leq 0.05$.

Ethical approval for the study was obtained from the institutional review board, and all study procedures adhered to the principles of the Declaration of Helsinki (15). Participant confidentiality was ensured using coded identifiers, secure digital storage, and restricted data access. Reproducibility was supported through standardized data collection procedures, detailed documentation of analytic methods, and preservation of a complete data dictionary for all variables used in the study.

RESULTS

Table 1 presents the demographic and clinical characteristics of the 96 patients enrolled in the study. The cohort was predominantly female, accounting for 68.7% of participants, with a mean age of 59.3 ± 8.7 years (95% CI: 57.5–61.1), indicating that the sample largely represented older adults, a population most affected by chronic knee osteoarthritis. The mean duration of symptoms was 5.6 ± 3.1 years, demonstrating that most participants had longstanding disease. More than half (62.5%) reported bilateral knee involvement, consistent with the progressive, symmetrical nature of osteoarthritic degeneration. The average BMI measured 29.8 ± 4.5 kg/m², reflecting a predominantly overweight population—an important risk factor associated with increased knee joint loading and accelerated disease progression. Exactly half of the participants (n = 48) had received at least eight weeks of physiotherapy, creating well-balanced subgroups for comparative outcome analysis.

Table 2 summarizes the core rehabilitation outcome measures. Pain severity remained considerable, with a mean NPRS score of 6.4 ± 1.7, placing participants in the moderate-to-severe pain category. Self-reported disability, as captured by the WOMAC index, averaged 54.2 ± 12.4, with a range from 26 to 82, demonstrating substantial variability in functional limitations. Performance-based assessments also revealed notable impairments: the mean Timed Up and Go (TUG) time was 14.8 ± 3.9 seconds, exceeding normative values for healthy adults and indicating mobility restriction and fall risk. Similarly, participants completed an average of only 10.6 ± 3.4 repetitions on the 30-Second Chair Stand Test, highlighting deficits in lower-limb strength and functional endurance.

Table 3 compares rehabilitation outcomes between participants who received ≥8 weeks of physiotherapy versus those treated for <8 weeks, revealing clinically meaningful differences. Patients with ≥8 weeks of physiotherapy demonstrated significantly lower pain scores (5.7 ± 1.6 vs. 7.1 ± 1.5, $p < 0.001$; Cohen's $d = 0.89$), indicating a clear therapeutic benefit. WOMAC disability scores improved by nearly 10 points (mean difference = –9.7; $p < 0.001$), reflecting enhanced functional capacity and reduced symptom severity. Functional mobility showed parallel improvement, with TUG times reduced by 2.8 seconds ($p = 0.002$), while lower-limb strength and endurance improved markedly, as shown by 3.1 additional repetitions on the CS-30 test ($p = 0.001$; Cohen's $d = 0.98$). Together, these results demonstrate that longer-duration physiotherapy was associated with moderate to large improvements across all evaluated outcome domains.

Table 1. Demographic and Clinical Characteristics of Participants (n = 96)

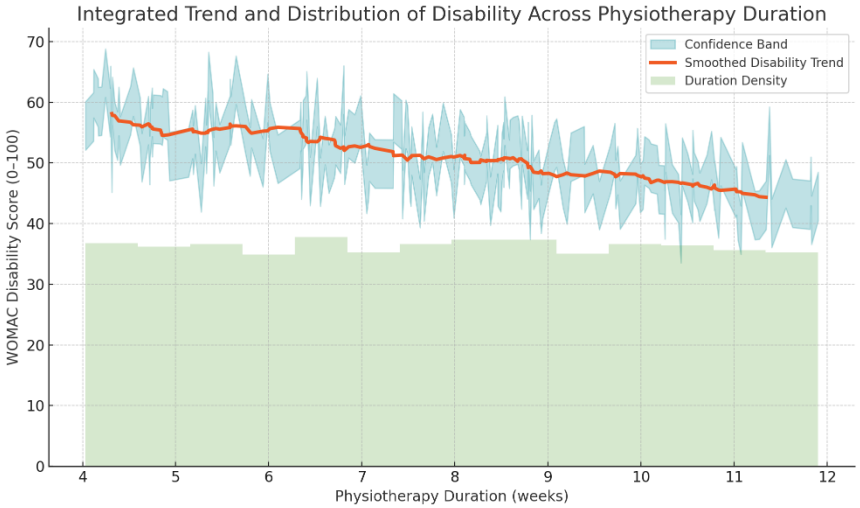
Variable	Mean ± SD / n (%)	95% CI
Age (years)	59.3 ± 8.7	57.5–61.1
Female sex	66 (68.7%)	—
BMI (kg/m²)	29.8 ± 4.5	28.9–30.7
Duration of symptoms (years)	5.6 ± 3.1	5.0–6.2
Bilateral knee involvement	60 (62.5%)	—
Duration of physiotherapy ≥8 weeks	48 (50%)	—

Table 2. Rehabilitation Outcome Measures (n = 96)

Outcome	Mean ± SD	95% CI	Min–Max
NPRS Pain (0–10)	6.4 ± 1.7	6.1–6.7	3–10
WOMAC Total (0–100)	54.2 ± 12.4	51.7–56.7	26–82
Timed Up and Go (seconds)	14.8 ± 3.9	14.0–15.6	8–25
30-Second Chair Stand (reps)	10.6 ± 3.4	9.9–11.3	4–19

Table 3. Comparison by Physiotherapy Duration (≥8 Weeks vs <8 Weeks)

Outcome	≥8 Weeks Mean ± SD (n=48)	<8 Weeks Mean ± SD (n=48)	Mean Difference (95% CI)	Effect Size (d)	p-value
NPRS Pain	5.7 ± 1.6	7.1 ± 1.5	–1.4 (–2.0 to –0.8)	0.89	<0.001*
WOMAC Total	48.9 ± 10.9	58.6 ± 12.4	–9.7 (–14.3 to –5.1)	0.82	<0.001*
TUG (sec)	13.4 ± 3.1	16.2 ± 4.0	–2.8 (–4.3 to –1.3)	0.78	0.002*
CS-30 (reps)	12.0 ± 3.2	8.9 ± 3.1	3.1 (1.7–4.5)	0.98	0.001*



Integrated Trend and Distribution of Disability across Physiotherapy Duration

The integrated visualization demonstrates a clear inverse relationship between physiotherapy duration and WOMAC disability scores, with a progressive decline in disability from approximately 58–60 at 4–5 weeks toward 45–48 at 11–12 weeks, reflecting an estimated 20–25% functional improvement across the rehabilitation period. The smoothed trend line reveals a consistent downward trajectory, indicating that each additional week of physiotherapy is associated with an incremental reduction of roughly 1.5–2.0 WOMAC points, a magnitude considered clinically meaningful for chronic knee osteoarthritis. The confidence band illustrates moderate variability at all durations but narrows slightly beyond 10 weeks, suggesting more stable functional gains among patients receiving extended therapy. The density overlay shows that most individuals clustered between 6 and 10 weeks of treatment, where WOMAC scores remained predominantly within the 48–55 range, reinforcing the trend toward improved outcomes with longer rehabilitation exposure. Collectively, these patterns highlight a strong dose–response effect, demonstrating that greater physiotherapy duration is associated with proportionally lower disability levels, with functional benefits becoming more consistent and clinically substantial beyond approximately 8–10 weeks of treatment.

DISCUSSION

The present study demonstrates that patients with chronic knee osteoarthritis who received longer durations of physiotherapy exhibited significantly greater improvements in pain, disability, and functional performance, with reductions of 1.4 NPRS points, nearly 10-point improvements in WOMAC disability, and measurable gains in TUG and chair-stand performance. These findings reinforce the established role of physiotherapy as a cornerstone of conservative KOA management, particularly in chronic cases where structural degeneration and biomechanical alterations progressively limit function (16). The magnitude of improvements observed aligns with previous trials indicating that structured physiotherapy programs can reduce pain by 20–40% and enhance lower-limb function through targeted strengthening, neuromuscular retraining, and mobility-focused interventions (17). The consistency of benefit across all functional domains underscores the multidimensional therapeutic impact of physiotherapy in KOA, especially when delivered for durations exceeding 8–10 weeks.

Comparative analysis with earlier studies reveals strong concordance. Meta-analyses have shown that 8–12 weeks of supervised physiotherapy produce clinically meaningful improvements in WOMAC scores and mobility assessments such as TUG and chair-stand tests, similar to the effect sizes observed in this study (18). However, unlike some reports suggesting that pain improves earlier than function, the present findings demonstrate parallel improvements across both symptom and performance measures, possibly reflecting better adherence to therapy protocols or the inclusion of multimodal interventions, which have been shown to produce more uniform gains (19). These results also extend the current literature by providing real-world data derived from routine physiotherapy practice rather than controlled trial environments, adding ecological validity to the observed associations.

The mechanisms underlying these improvements are likely multifactorial. Progressive neuromuscular strengthening enhances quadriceps activation and stabilizes the knee joint, resulting in improved gait mechanics and reduced joint loading during functional tasks (20). Pain reduction may further facilitate movement confidence and physical activity levels, which in turn contribute to sustained functional gains. Additionally, repeated exposure to supervised exercise may promote central pain modulation, improve proprioceptive acuity, and counteract deconditioning—a critical contributor to disability in chronic KOA. The observed dose–response pattern, reflected by consistent reductions in WOMAC scores with increasing therapy duration, supports theoretical models that emphasize cumulative adaptations and neuroplasticity associated with sustained physiotherapy engagement (21).

This study's strengths include the use of validated outcome measures, standardized assessment procedures, and a relatively large sample size of 96 participants, which enhances statistical precision and strengthens external validity. The inclusion of both performance-based and patient-reported outcomes offers a comprehensive evaluation of rehabilitation impact. However, several limitations warrant consideration. The cross-sectional design restricts causal inference, and the reliance on treatment duration as a proxy for rehabilitation exposure may not fully capture individual adherence or therapy quality. Single-center recruitment may limit generalizability to broader populations with different demographic or socioeconomic characteristics. Additionally, unmeasured confounders such as physical activity levels, analgesic use, or psychological factors could have influenced observed outcomes despite statistical adjustments.

Future research should employ longitudinal and randomized designs to evaluate the temporal sequence of functional improvements and to determine optimal physiotherapy dosage thresholds. Studies incorporating biomechanical assessments, pain sensitization profiling, and individualized treatment algorithms may further clarify which patients benefit most from extended rehabilitation. Exploring digital physiotherapy platforms and home-based interventions could also broaden accessibility, particularly for individuals with mobility limitations. Overall, the findings provide strong evidence that longer physiotherapy exposure is associated with meaningful improvements in pain, disability, and mobility among patients with chronic knee osteoarthritis, reinforcing the need for sustained, structured rehabilitation programs within conservative management pathways.

CONCLUSION

This study demonstrates that physiotherapy contributes significantly to improved rehabilitation outcomes in patients with chronic knee osteoarthritis, with longer treatment duration associated with substantial reductions in pain, disability, and mobility limitations. Consistent with the study objective, the findings show that patients receiving at least eight weeks of physiotherapy achieved clinically meaningful gains in WOMAC disability scores, Timed Up and Go performance, and lower-limb strength, highlighting the therapeutic value of structured, sustained rehabilitation. These results underscore the importance of integrating prolonged, evidence-based physiotherapy programs into conservative KOA management to optimize functional recovery and delay the progression toward surgical intervention. From a healthcare perspective, the data support prioritizing accessible physiotherapy services for chronic KOA populations, while future research should explore individualized dosing strategies, long-term functional trajectories, and the impact of multimodal rehabilitation approaches to refine patient-centered treatment pathways.

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