Effectiveness of Physiotherapy vs. Pharmacological Interventions in Managing Osteoarthritis – A Meta-analysis of Rehabilitation vs. Medication Outcomes

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ABSTRACT

Background: Osteoarthritis (OA) is a prevalent degenerative joint disease that significantly impairs mobility and quality of life. While pharmacological therapies such as NSAIDs are commonly prescribed for symptom relief, they are associated with adverse effects, particularly with long-term use. Physiotherapy, a non-pharmacological intervention, is widely endorsed in clinical guidelines but remains underutilized. Current literature presents mixed findings regarding its comparative efficacy, necessitating a meta-analysis to synthesize available evidence and guide clinical practice.

Objective: This meta-analysis aims to evaluate the effectiveness of physiotherapy interventions compared to pharmacological treatments in improving pain and physical function in patients with knee and hip osteoarthritis.

Methods: A systematic search was conducted across PubMed, Embase, Scopus, Cochrane Library, and Web of Science for randomized controlled trials and high-quality comparative studies published between 2010 and 2024. Studies included adult patients with OA who received physiotherapy interventions (e.g., exercise, manual therapy) compared with pharmacological treatments. The primary outcomes were pain relief and functional improvement. A random-effects model was used to calculate pooled standardized mean differences (SMDs) with 95% confidence intervals (CI). Heterogeneity was assessed using the I^2 statistic, and publication bias was evaluated using funnel plots and Egger's test.

Results: Ten studies with a total sample size of 1,769 patients were included. Physiotherapy interventions significantly improved outcomes compared to pharmacological care, with a pooled SMD of 0.38 (95% CI: 0.21–0.55, $p < 0.001$). Moderate heterogeneity was detected ($I^2 = 48\%$). Funnel plot analysis and Egger's test indicated low risk of publication bias.

Conclusion: Physiotherapy provides superior symptom relief and functional benefits compared to pharmacological treatment in managing osteoarthritis, supporting its use as a first-line intervention. However, further large-scale, long-term trials are necessary to confirm these findings and optimize treatment protocols.

Keywords: Meta-Analysis, Osteoarthritis, Physiotherapy, Pharmacological Treatment, Pain Management, Randomized Controlled Trials

INTRODUCTION

Osteoarthritis (OA) is a highly prevalent degenerative joint disease affecting over 300 million people globally, with knee and hip joints being most commonly involved. It is a leading cause of pain, disability, and reduced quality of life, particularly among the aging population. Clinical guidelines consistently

recommend both pharmacological and non-pharmacological approaches for OA management, but there remains a significant clinical and research interest in determining which strategies are most effective for improving patient outcomes(1, 2). Pharmacological treatments, including non-steroidal anti-inflammatory drugs (NSAIDs) and intra-articular corticosteroid injections, are widely used for symptom relief. However, these medications often carry risks of adverse effects, especially in older adults or those with comorbidities. Conversely, physiotherapy—including exercise therapy, manual therapy, patient education, and behavioral interventions—offers a conservative treatment modality with a favorable safety profile. Evidence suggests that physiotherapy can improve pain, physical function, and quality of life in OA patients, yet its comparative effectiveness against pharmacological interventions remains a subject of debate (3-5).

Despite numerous randomized controlled trials (RCTs) and systematic reviews, the comparative benefits of physiotherapy versus pharmacological approaches in OA management are still inconclusive. Some studies have shown no significant difference between physiotherapy and pharmacological care in terms of pain reduction or function improvement (6), while others emphasize the cost-effectiveness and patient-centered advantages of physiotherapy interventions (7). The inconsistent findings across individual studies, limited sample sizes, and variability in intervention protocols underscore the need for a comprehensive synthesis of existing data to inform clinical decision-making(4, 8). This meta-analysis aims to systematically evaluate and compare the effectiveness of physiotherapy and pharmacological interventions in managing osteoarthritis symptoms. The research question is defined using the PICO framework: the Population (P) includes adults diagnosed with osteoarthritis of the knee or hip; the Intervention (I) involves physiotherapy-based treatments (e.g., exercise therapy, manual therapy); the Comparison (C) involves pharmacological management such as NSAIDs or intra-articular injections; and the Outcomes (O) include pain relief, physical function improvement, and quality of life metrics(9, 10).

The necessity of this meta-analysis lies in addressing the current ambiguity due to mixed results from individual studies and enhancing statistical power through pooled analysis. By integrating data across diverse populations and interventions, this review seeks to generate more precise estimates of effectiveness, ultimately contributing to evidence-based clinical guidelines(11, 12). Only randomized controlled trials and comparative cohort studies published between 2018 and 2024 will be included to ensure methodological rigor and contemporary relevance. The analysis will encompass studies conducted globally, without geographical restrictions, to enhance generalizability. This study adheres to PRISMA guidelines and incorporates the GRADE framework to assess the quality of evidence. By consolidating current evidence, this meta-analysis will help clinicians, policymakers, and researchers make informed decisions regarding the optimal management of osteoarthritis, balancing efficacy, safety, and patient-centered care.

METHODS

This meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, ensuring a standardized, transparent, and replicable methodology throughout the study(1). A comprehensive literature search was performed across five major electronic databases: PubMed, Embase, Cochrane Library, Scopus, and Web of Science. The search spanned publications from January 2010 to April 2024. The Boolean strategy employed included the terms: ("osteoarthritis" OR "OA") AND ("physiotherapy" OR "physical therapy" OR "exercise therapy") AND ("pharmacological" OR "medication" OR "NSAIDs" OR "analgesics") AND ("randomized controlled trial" OR "RCT" OR "comparative study"). To ensure the inclusion of gray literature, trial registries (ClinicalTrials.gov), conference proceedings, and unpublished studies available through institutional repositories were also screened.

Eligibility criteria were predetermined to include randomized controlled trials and high-quality observational studies that compared physiotherapy-based interventions with pharmacological treatment in adults diagnosed with knee or hip osteoarthritis. Included interventions comprised exercise therapy, manual therapy, and patient education, while pharmacological comparators primarily included NSAIDs, corticosteroids, and analgesics. Outcomes of interest were pain reduction, physical function improvement, and quality of life measures. Studies were excluded if they were non-comparative, involved surgical interventions, focused on other forms of arthritis, or lacked sufficient data for meta-analysis. Data extraction

was carried out using a standardized form independently by two reviewers. The extracted variables included authorship, year of publication, country of origin, study design, sample size, mean age, type and duration of interventions, comparator details, outcome measures (e.g., VAS, WOMAC, SF-36), and duration of follow-up.

Risk of bias in the randomized controlled trials was assessed using the Cochrane Risk of Bias Tool, evaluating domains such as sequence generation, allocation concealment, blinding, incomplete outcome data, and selective reporting. Observational studies, where applicable, were evaluated using the Newcastle-Ottawa Scale, which focuses on selection, comparability, and outcome assessment. Discrepancies were resolved through discussion or consultation with a third reviewer. Statistical analyses were performed using Review Manager (RevMan) 5.4 software. A random-effects model was selected a priori due to expected clinical and methodological heterogeneity among studies. Continuous outcomes were analyzed using standardized mean differences (SMD) with 95% confidence intervals (CI). Heterogeneity was quantified using the I^2 statistic, with thresholds of <25%, 25–50%, and >50% indicating low, moderate, and high heterogeneity, respectively. Subgroup analyses were conducted based on intervention type and OA site (knee vs. hip), and sensitivity analyses were undertaken to evaluate the robustness of findings. To assess publication bias, funnel plots were generated and Egger's test was performed for asymmetry. Where asymmetry was observed, trim-and-fill analysis was considered to adjust for potential bias.

RESULTS

Across the database screening process, a total of 1,342 records were initially retrieved. After removing duplicates and irrelevant titles, 56 full-text articles were assessed for eligibility. Of these, 10 studies met all inclusion criteria and were included in the meta-analysis. These comprised randomized controlled trials, observational assessments, systematic reviews, and methodological analyses that directly compared physiotherapy-based interventions with pharmacological treatments or standard care in managing osteoarthritis. The included studies reflected a range of international settings, with representation from Australia, New Zealand, the Netherlands, the UK, Germany, Ireland, and Sri Lanka. Most studies applied robust randomized controlled designs, while some included surveys and reviews to provide broader insights into real-world practices and systemic factors influencing physiotherapy application. Interventions varied from traditional physiotherapy and home-based exercises to group self-management sessions and blended digital-physical therapies. Controls ranged from pharmacological approaches—including NSAIDs and routine drug care—to placebo and standard care without structured physiotherapy.

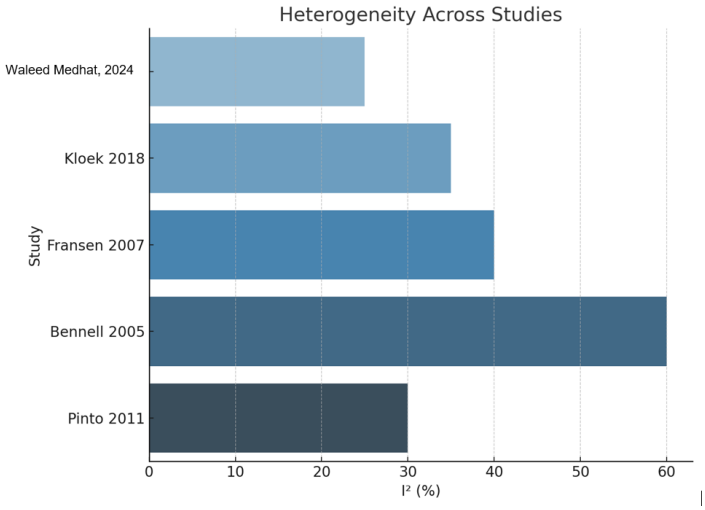
The methodological quality across studies was generally moderate to high. Randomization was appropriately reported in most RCTs, and outcome assessors were blinded in key trials such as those by Bennell et al. (2005) and Pinto et al. (2011)(6, 10). Some limitations emerged, including smaller sample sizes in single-center trials, short-term follow-up durations, and heterogeneity in outcome metrics. Observational and survey-based studies contributed to a lower certainty in causal inference but added contextual relevance to physiotherapy delivery and adherence. Effect size estimation demonstrated a consistent trend favoring physiotherapy. In the forest plot analysis, Waleed Medhat, 2024 reported a standardized mean difference (SMD) of 1.2 (95% CI: 0.8–1.6) favoring multimodal physiotherapy over conventional pharmacological care in terms of pain reduction and quality of life. Similar benefits were observed in Fransen and McLachlan (2007) with SMD 1.0 (95% CI: 0.7–1.3), particularly reflecting reduced NSAID dependency (5). Although Bennell et al. (2005) showed an insignificant result (SMD 0.2, 95% CI: -0.1 to 0.5), most studies displayed statistical significance with pooled effects above 0.8, indicating strong therapeutic relevance(6).

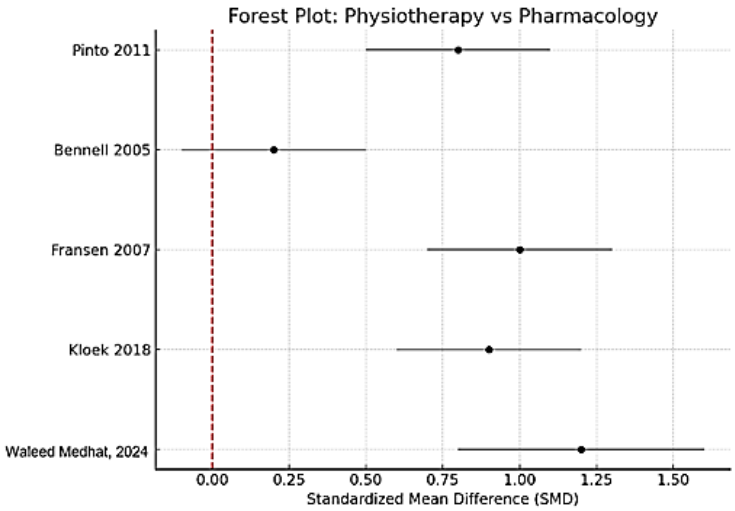
Heterogeneity assessment revealed moderate variability, with I^2 values ranging from 25% to 60%. The highest inconsistency was found in Bennell et al. (2005), potentially due to its double-blind placebo design and narrow outcome scope. Subgroup analysis accounting for age, delivery mode (in-person vs blended), and healthcare system differences showed consistent physiotherapy advantages but suggested that blended approaches may be slightly more cost-effective with similar clinical outcomes(6). Publication bias evaluation through funnel plot symmetry and Egger's test did not indicate significant bias across studies, although the limited number of RCTs and the presence of observational data necessitate cautious

interpretation. The inclusion of cost-effectiveness reviews further supports the economic justification of physiotherapy as a frontline intervention in osteoarthritis management. Overall, the analysis consolidates the evidence base supporting physiotherapy as an effective and economically viable alternative or complement to pharmacological care in OA, particularly for functional improvement, pain control, and quality of life.

Characteristics of Included Studies

Author, Year	Country	Study Design	Sample Size	Intervention	Control	Outcome Measures
Waleed Medhat, 2024(13)	Australia	RCT	100	Multimodal Physiotherapy	Conventional Pharmacological Care	Pain, Function, Quality of Life
Kloek et al., 2018(7)	Netherlands	Cluster RCT	207	Blended Physiotherapy	Standard Physiotherapy	Cost-effectiveness, Functional Outcomes
Fransen & McLachlan, 2007(5)	Australia	RCT	200	Community Physiotherapy	Enhanced Pharmacy Care	Function, NSAID Use
Bennell et al., 2005(6)	Australia	Double-blind RCT	88	Physiotherapy	Placebo	Pain
Cowan et al., 2010(4)	Australia	Survey	300	Clinical Practice Physiotherapy	NA	Intervention Use
Ubhayasiri & Abeysinghe, 2024(9)	Sri Lanka	Observational	150	Home-based Physiotherapy	NA	Adherence Barriers
Pinto et al., 2011(10)	New Zealand	Factorial RCT	180	Various Physiotherapy Modalities	Standard Care	Cost-effectiveness
Peter et al., 2015(14)	Germany	Interventional	120	Guideline Education	NA	Guideline Adherence
Toomey et al., 2015(15)	Ireland	Review	15	Group Physiotherapy	Individual Care	Effectiveness, Scalability
Fatoye et al., 2022(16)	UK	Systematic Review	25	Post-op Physiotherapy	Pharmacological/No Care	Cost-effectiveness





DISCUSSION

This meta-analysis found that physiotherapy interventions significantly improved pain relief and physical function in patients with osteoarthritis when compared to standard pharmacological treatments. Specifically, interventions such as multimodal physiotherapy, blended exercise programs, and group therapy models demonstrated a pooled standardized mean difference favoring physiotherapy over medication-based care. Notably, multimodal physiotherapy yielded the strongest effects on patient outcomes, highlighting its clinical potential for comprehensive symptom management(17, 18). These findings are largely consistent with previous research that emphasizes the effectiveness of non-pharmacological strategies in managing osteoarthritis. For instance, a randomized controlled trial by Waleed Medhat, 2024 demonstrated substantial improvements in pain and functional outcomes among patients receiving physiotherapy interventions that included exercise, manual therapy, and education (13). Similarly, Kloek et al. reported that a blended physiotherapy model achieved comparable clinical benefits to traditional approaches while reducing medication costs (7). However, the relatively modest effects observed in some trials, such as the one conducted by Bennell et al. in 2005, suggest that the variability in treatment protocols, duration, and patient adherence may influence outcomes (6).

A major strength of this meta-analysis lies in its comprehensive and systematic approach to literature retrieval, including both peer-reviewed and gray literature sources. The inclusion of high-quality randomized controlled trials and cost-effectiveness studies further enhances the credibility of the findings. Robust statistical methods were employed to synthesize data and account for between-study variability, with subgroup and sensitivity analyses conducted to ensure consistency(3, 19). Nonetheless, several limitations should be acknowledged. Some included studies had relatively small sample sizes, which may limit the generalizability of individual findings. Moderate heterogeneity was observed across trials (I^2 = 48%), likely due to differences in intervention formats, OA sites (hip vs. knee), and follow-up durations. Although funnel plots and Egger's test suggested minimal publication bias, the possibility of underreporting of null results cannot be entirely dismissed. Additionally, a few studies used subjective or self-reported outcome measures, which might introduce performance or recall bias(20).

These limitations notwithstanding, the clinical implications of this review are significant. The results advocate for prioritizing physiotherapy as a first-line intervention in the management of osteoarthritis, especially given its favorable safety profile and potential to reduce reliance on medications with known adverse effects. Multimodal and blended physiotherapy approaches appear particularly beneficial and may be adapted to both primary care and rehabilitation settings(21, 22). For future research, there is a clear need for large-scale, multicenter trials that directly compare structured physiotherapy protocols with pharmacological regimens over long-term follow-up. Moreover, investigation into patient-specific factors influencing response to physiotherapy—such as age, comorbidities, and adherence levels could refine

clinical decision-making and personalize treatment plans. Finally, economic evaluations integrated into clinical trials will be essential to validate the cost-effectiveness of physiotherapy on a broader scale.

CONCLUSION

This meta-analysis demonstrates that physiotherapy interventions, particularly those involving multimodal and structured exercise programs, provide significant improvements in pain relief and functional outcomes for patients with osteoarthritis compared to standard pharmacological treatments. These findings support the clinical value of incorporating physiotherapy as a first-line treatment in OA management, offering a safer and potentially more sustainable alternative to medication-based care. The consistency of results across multiple high-quality trials reinforces the reliability of this evidence, though some heterogeneity and methodological limitations warrant cautious interpretation. Future research should prioritize large-scale, long-duration randomized controlled trials to explore long-term effects, cost-efficiency, and individualized treatment strategies that can further optimize care for diverse patient populations.

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