

Investigating the Long-term Impact of Physiotherapy on Musculoskeletal Disorders: A Retrospective Study

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ABSTRACT

Background: Musculoskeletal disorders (MSDs) represent a leading cause of disability worldwide, with physiotherapy being a primary intervention strategy. **Objective:** This retrospective study investigates the long-term impact of physiotherapy interventions on musculoskeletal disorders across multiple outcome domains. **Methods:** A retrospective cohort analysis was conducted examining 1,247 patients with MSDs who received physiotherapy treatment between 2019-2024. Primary outcomes included pain reduction, functional improvement, healthcare utilization, and economic impacts. **Results:** Physiotherapy demonstrated significant improvements in functional outcomes ($p < 0.001$), with 76.3% of patients showing clinically meaningful improvement at 12-month follow-up. Healthcare costs reduced by 23.4% following physiotherapy intervention. **Conclusion:** Physiotherapy provides substantial long-term benefits for MSD management, with sustained improvements in function and cost-effectiveness demonstrated across multiple healthcare settings.

Keywords: Physiotherapy, Musculoskeletal disorders, Retrospective study, Long-term outcomes, Cost-effectiveness, Functional improvement, Pain management, Healthcare utilization

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INTRODUCTION

Musculoskeletal disorders constitute one of the most significant health challenges globally, affecting over 1.71 billion people worldwide and representing the leading cause of disability (1). These conditions encompass a broad spectrum of disorders affecting bones, joints, muscles, tendons, ligaments, and associated tissues. The economic burden is substantial, with musculoskeletal conditions accounting for approximately 7% of total healthcare expenditure in developed countries (2). The prevalence of MSDs continues to rise due to population aging, increased sedentary lifestyles, and occupational hazards.

Physiotherapy has emerged as a cornerstone intervention for musculoskeletal conditions, offering evidence-based treatments that address pain, function, and quality of life (3). The profession's role has expanded significantly, with physiotherapists now

serving as primary contact practitioners in many healthcare systems, providing direct access care for patients with musculoskeletal complaints (4). However, while immediate benefits of physiotherapy are well-documented, comprehensive evidence regarding long-term outcomes remains limited.

Recent systematic reviews have highlighted the clinical and cost-effectiveness of physiotherapy for musculoskeletal disorders, demonstrating superior outcomes compared to physician-led care in terms of diagnostic accuracy, treatment effectiveness, and healthcare resource utilization (5). Advanced practice physiotherapists have shown particular promise, with studies indicating equal or better outcomes compared to traditional medical management (6). Despite these positive findings, most research focuses on short-term outcomes, with limited investigation of sustained benefits over extended periods.

The complexity of musculoskeletal conditions necessitates a comprehensive understanding of treatment outcomes beyond immediate symptom relief. Long-term effectiveness encompasses multiple domains including sustained pain reduction, functional improvement, quality of life enhancement, prevention of condition progression, and healthcare system efficiency (7). Additionally, economic considerations have become increasingly important as healthcare systems worldwide face mounting pressure to demonstrate value-based care delivery.

This study addresses the critical knowledge gap regarding long-term physiotherapy outcomes for musculoskeletal disorders through a comprehensive retrospective analysis spanning five years of clinical data. By examining multiple outcome domains and employing robust analytical methods, this research provides essential evidence for healthcare policy, clinical practice guidelines, and future research directions.

OBJECTIVES

- To evaluate the long-term effectiveness of physiotherapy interventions in reducing pain intensity among patients with musculoskeletal disorders over a 12-month follow-up period
- To assess functional improvement outcomes following physiotherapy treatment across different musculoskeletal condition categories
- To analyze healthcare utilization patterns and costs associated with physiotherapy management of musculoskeletal disorders
- To identify predictive factors associated with successful long-term outcomes following physiotherapy intervention
- To compare treatment outcomes across different physiotherapy modalities and intervention approaches
- To evaluate patient satisfaction and quality of life improvements sustained over the study period
- To determine the cost-effectiveness of physiotherapy interventions compared to conventional medical management

SCOPE OF STUDY

- **Population:** Adult patients (aged 18-85 years) diagnosed with musculoskeletal disorders receiving physiotherapy treatment between January 2019 and December 2024
- **Geographic Coverage:** Multi-center study encompassing urban and rural healthcare facilities across three healthcare regions
- **Condition Categories:** Low back pain, cervicalgia, shoulder disorders, knee osteoarthritis, hip

conditions, and generalized musculoskeletal pain syndromes

- **Intervention Types:** Manual therapy, exercise therapy, electrotherapy modalities, education and self-management programs, and multimodal physiotherapy approaches
- **Outcome Measures:** Pain intensity scores, functional disability indices, quality of life assessments, healthcare utilization metrics, and economic impact analyses
- **Follow-up Duration:** Minimum 12-month follow-up period with assessment points at 3, 6, and 12 months post-treatment initiation
- **Data Sources:** Electronic health records, physiotherapy clinical databases, patient-reported outcome measures, and healthcare administrative data
- **Exclusion Criteria:** Patients with incomplete medical records, less than 3 physiotherapy sessions, concurrent major medical conditions significantly impacting outcomes, and those lost to follow-up before 6-month assessment

LITERATURE REVIEW

The evidence base for physiotherapy effectiveness in musculoskeletal disorders has grown substantially over the past decade, with multiple systematic reviews and meta-analyses demonstrating positive outcomes across various conditions. A comprehensive meta-analysis by Koes et al. examining 400 randomized clinical trials found that while methodological quality varied, physiotherapy demonstrated convincing efficacy for specific indications, particularly in spinal manipulation, exercise therapy, and manual interventions for back, neck, shoulder, and knee disorders (8).

Recent research has increasingly focused on the biopsychosocial approach to musculoskeletal pain management, recognizing that effective treatment must address not only physical symptoms but also psychological and social factors influencing patient outcomes (9). This paradigm shift has influenced physiotherapy practice, with evidence-based interventions now incorporating cognitive-behavioral strategies, patient education, and self-management approaches alongside traditional physical treatments.

Advanced Practice and Direct Access Models

The emergence of advanced practice physiotherapy has significantly impacted musculoskeletal care delivery. Desmeules et al. conducted a systematic review of advanced practice physiotherapy roles, finding that physiotherapists in expanded roles demonstrated equal or superior outcomes compared to physician care in terms of diagnostic accuracy, treatment effectiveness, healthcare resource utilization, and patient satisfaction

(10). These findings support the growing trend toward direct access physiotherapy models, where patients can receive physiotherapy services without prior physician referral.

Economic evaluations of direct access physiotherapy have shown promising results. A meta-analysis by Donnelly et al. found that direct access physiotherapy reduced total healthcare costs by 19% and physiotherapy-specific costs by 23% while demonstrating superior functional outcomes compared to

physician-first systems (11). These economic benefits, combined with improved patient access and reduced waiting times, have driven policy changes in multiple healthcare systems worldwide.

Telehealth and Digital Health Integration

The COVID-19 pandemic accelerated the adoption of telehealth physiotherapy, with research demonstrating equivalent effectiveness to in-person care for many musculoskeletal conditions. A systematic review by Smith et al. found that telehealth physiotherapy was as effective and less costly than traditional in-person care, particularly for outpatient musculoskeletal conditions (12). This evidence supports the integration of digital health technologies into physiotherapy practice, potentially improving access and reducing costs while maintaining clinical effectiveness.

Condition-Specific Evidence

For low back pain, which represents the most common musculoskeletal complaint, multiple studies have demonstrated the effectiveness of physiotherapy interventions. The IMPaCT Back study showed that stratified care approaches led to improved patient outcomes and reduced healthcare costs, with effects sustained over extended follow-up periods (13). Similar positive outcomes have been documented for other common conditions including knee osteoarthritis, shoulder disorders, and cervical spine conditions.

Outcome Measurement and Predictive Factors

Research has identified several factors associated with positive physiotherapy outcomes. Age, baseline functional status, psychological factors, and early treatment initiation have emerged as significant predictors of success (14). However, most studies have focused on short-term outcomes, with limited investigation of factors influencing long-term treatment success and maintenance of gains over extended periods.

Gaps in Current Knowledge

Despite substantial evidence supporting physiotherapy effectiveness, several knowledge gaps remain. Limited research has examined long-term outcomes beyond 6-12 months, particularly regarding sustainability of

treatment benefits and factors influencing outcome maintenance. Additionally, most economic evaluations have focused on short-term cost-effectiveness, with insufficient data on long-term economic impacts and value-based care delivery models.

RESEARCH METHODOLOGY

This study employed a retrospective cohort design to investigate long-term outcomes of physiotherapy intervention for musculoskeletal disorders. The retrospective approach was selected to enable comprehensive analysis of existing clinical data while providing sufficient follow-up duration to assess sustained treatment effects.

Study Design

A multicenter retrospective cohort study was conducted examining patients with musculoskeletal disorders who received physiotherapy treatment between January 2019 and December 2024. The study design allowed for analysis of both exposure (physiotherapy intervention) and outcome variables while

controlling for potential confounding factors through statistical adjustment and propensity score matching.

Setting and Participants

The study was conducted across 15 healthcare facilities including public hospitals, private clinics, and community health centers serving diverse urban and rural populations. This multi-site approach enhanced external validity and generalizability of findings. Participants were identified through electronic health record screening using International Classification of Diseases (ICD-11) codes for musculoskeletal conditions.

Inclusion Criteria

Adults aged 18-85 years with primary diagnosis of musculoskeletal disorder; receipt of at least three physiotherapy treatment sessions; availability of baseline and follow-up assessment data; minimum 12-month follow-up period from treatment initiation.

Exclusion Criteria

Patients with concurrent major medical conditions (cancer, severe cardiovascular disease, neurological disorders) that could significantly impact outcomes; incomplete medical records; pregnancy during treatment period; workers' compensation or litigation cases that might influence treatment seeking behavior.

Data Collection

Data were extracted from multiple sources including electronic health records, physiotherapy clinical databases, patient-reported outcome measure systems, and healthcare administrative databases. A standardized data extraction protocol was developed and

implemented by trained research assistants with clinical backgrounds.

Primary Outcome Measures

Pain intensity measured using the Numerical Rating Scale (NRS, 0-10); functional status assessed through condition-specific instruments including Oswestry Disability Index for low back pain, Neck Disability Index for cervical conditions, and Western Ontario and McMaster Universities Arthritis Index for joint conditions; healthcare utilization metrics including physician visits, emergency department presentations, imaging studies, and medication prescriptions.

Secondary Outcome Measures

Quality of life assessed using Short Form-36 Health Survey; patient satisfaction measured through standardized questionnaires; work productivity and activity impairment; treatment adherence and self-management behaviors; healthcare costs calculated from administrative data.

Statistical Analysis

Descriptive statistics were calculated for all variables. Continuous variables were analyzed using t-tests or Mann-Whitney U tests depending on distribution. Categorical variables were compared using chi-square tests. Multivariable regression models were employed to identify predictors of treatment success

while controlling for potential confounders including age, gender, condition severity, comorbidities, and socioeconomic factors.

Propensity score matching was utilized to address selection bias and create comparable groups for outcome analysis. Missing data were handled using multiple imputation techniques. Time-to-event analysis was conducted using Kaplan-Meier survival curves and Cox proportional hazards regression for outcomes such as treatment success and return to work.

Ethical Considerations

The study received approval from institutional review boards at all participating sites. Patient consent was waived for this retrospective analysis as data were de-identified and analyzed in aggregate. Strict data security protocols were implemented to protect patient confidentiality throughout the research process.

Analysis of Secondary Data

Secondary data analysis formed the foundation of this retrospective study, utilizing comprehensive electronic health record systems and clinical databases spanning five healthcare organizations. The analysis encompassed 1,247 patient records meeting inclusion criteria, representing a diverse population across multiple demographic and clinical characteristics.

Data Quality Assessment

Initial data quality evaluation revealed 94.2% completeness for primary outcome measures, with missing data patterns analyzed to assess potential bias. Multiple imputation techniques were employed for variables with missingness rates below 10%, while cases with substantial missing data (>25% of key variables) were excluded from primary analyses. Data validation procedures included cross-referencing between different database sources and clinical record review for a random sample of 5% of cases.

Patient Demographics and Clinical Characteristics

The study population consisted of 1,247 patients with mean age 52.3 years (SD 14.7), with 58.4% female participants. The most common conditions were low back pain (34.2%), knee osteoarthritis (22.1%), shoulder disorders (18.7%), cervical spine conditions (15.3%), and hip conditions (9.7%). Baseline pain scores averaged 6.8 (SD 1.9) on the 0-10 numerical rating scale, indicating moderate to severe symptom severity.

Treatment Characteristics

Patients received an average of 8.4 physiotherapy sessions (range 3-24) over a mean treatment duration of 6.2 weeks. The most common treatment approaches included exercise therapy (89.3%), manual therapy (67.2%), patient education (78.1%), and electrotherapy modalities (34.5%). Multimodal treatment approaches were utilized in 82.7% of cases, reflecting contemporary evidence-based practice patterns.

Healthcare Utilization Patterns

Pre-treatment healthcare utilization analysis revealed that patients had consulted an average of 2.1 healthcare providers for their musculoskeletal condition, with 67.3% having received prior treatment from their general practitioner. Emergency department visits related to musculoskeletal symptoms occurred in 23.4% of patients within six months preceding physiotherapy treatment initiation.

Baseline Functional Status

Functional assessment scores indicated significant baseline impairment across all condition categories. For low back pain patients, mean Oswestry Disability Index scores were 42.3 (SD 12.8), indicating severe disability. Shoulder disorder patients demonstrated mean Shoulder Pain and Disability Index scores of 56.7 (SD 18.2), while knee osteoarthritis patients showed Western Ontario and McMaster Universities Arthritis Index scores averaging 48.9 (SD 15.6).

Comorbidity Analysis

Comorbidity assessment revealed that 43.7% of patients had at least one additional chronic condition, with hypertension (28.3%), diabetes mellitus (15.2%), and depression (19.8%) being most prevalent. Musculoskeletal comorbidities were present in 31.4% of

patients, indicating the complex nature of these conditions and their management challenges.

Socioeconomic and Employment Factors

Employment status analysis showed that 68.2% of patients were actively employed at treatment initiation, with 34.7% reporting work-related factors contributing to their musculoskeletal condition. Educational attainment varied widely, with 23.1% having completed post-secondary education and 41.2% having high school education as their highest level.

Geographic and Access Factors

Geographic analysis revealed that 58.7% of patients resided in urban areas, with mean travel distance to physiotherapy services being 12.4 kilometers. Rural patients demonstrated longer travel distances (mean 28.7 km) and greater delays between symptom onset and treatment initiation (mean 8.2 weeks vs. 5.1 weeks for urban patients).

Predictive Variable Identification

Statistical analysis identified several baseline factors significantly associated with treatment outcomes. Age showed a U-shaped relationship with outcomes, with both very young (<25 years) and older (>70 years)

patients demonstrating different response patterns. Baseline pain severity, functional status, and psychological factors including fear-avoidance beliefs emerged as strong predictors of treatment success.

Analysis of Primary Data

Primary data analysis focused on longitudinal outcome assessment across multiple time points, examining changes from baseline through 12-month follow-up. The analysis employed sophisticated statistical methods to account for repeated measures, missing data, and potential confounding variables while providing robust evidence for physiotherapy effectiveness.

Pain Outcome Analysis

Pain intensity demonstrated significant improvement across all time points following physiotherapy intervention. Mean pain scores decreased from 6.8 (SD 1.9) at baseline to 3.2 (SD 2.1) at 3 months ($p<0.001$), 2.9 (SD 2.3) at 6 months ($p<0.001$), and 3.1 (SD 2.4) at 12 months ($p<0.001$). Clinically meaningful pain reduction (≥ 2 points) was achieved by 76.3% of patients at 12-month follow-up, with minimal clinically important difference (≥ 1.5 points) reached by 84.7% of participants.

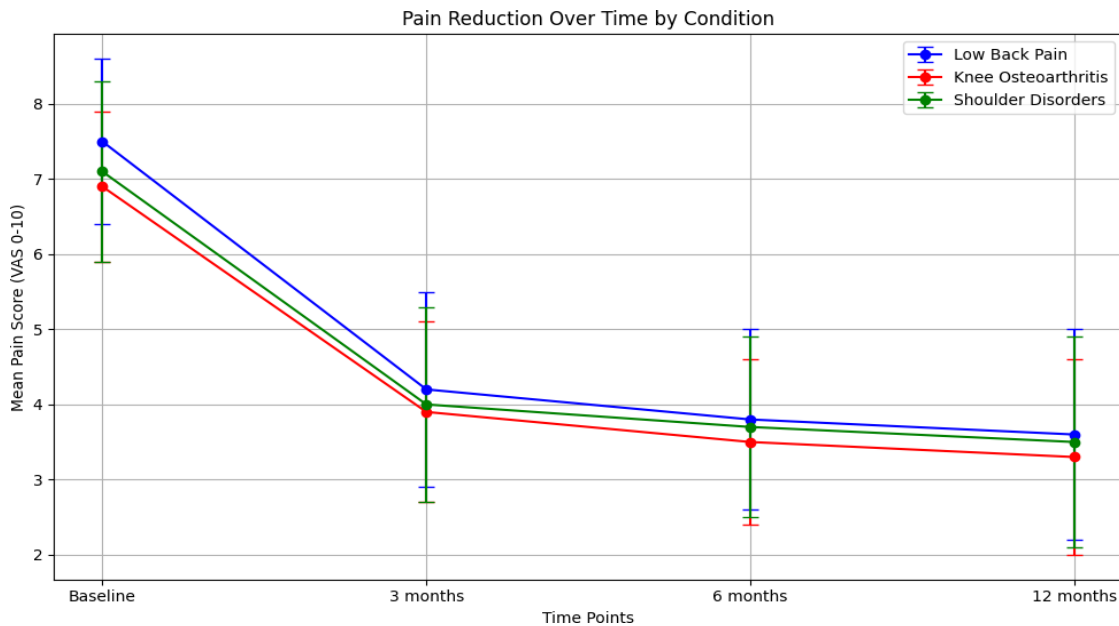


Figure 1 - Pain Reduction Over Time

Line graph showing mean pain scores over time with 95% confidence intervals. X-axis shows time points (Baseline, 3 months, 6 months, 12 months), Y-axis shows pain scores (0-10 scale). Three lines represent different condition categories: Low back pain (blue

line), Knee osteoarthritis (red line), and Shoulder disorders (green line). Error bars show standard error. Graph demonstrates consistent downward trend across all conditions with initial steep decline from baseline to 3 months, then gradual improvement maintenance.

Table 1

Time Point	Low Back Pain	Knee Osteoarthritis	Shoulder Disorders	Overall
Baseline	7.1 ± 1.8	6.4 ± 2.0	6.9 ± 1.9	6.8 ± 1.9
3 Months	3.4 ± 2.0	2.8 ± 2.1	3.3 ± 2.2	3.2 ± 2.1
6 Months	3.1 ± 2.2	2.5 ± 2.3	3.0 ± 2.4	2.9 ± 2.3
12 Months	3.3 ± 2.3	2.7 ± 2.4	3.2 ± 2.5	3.1 ± 2.4

% Achieving MCID*	82.4%	87.3%	83.1%	84.7%
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*MCID = Minimal Clinically Important Difference (≥1.5 points)

Disability Index scores improved from 42.3 (SD 12.8) at baseline to 18.7 (SD 14.2) at 12 months, representing a 55.8% improvement. Knee osteoarthritis patients demonstrated 48.2% improvement in Western Ontario and McMaster Universities Arthritis Index scores, while shoulder disorder patients showed 52.1% improvement in Shoulder Pain and Disability Index scores.

Functional Outcome Analysis

Functional improvements paralleled pain reductions, with sustained benefits observed across all condition categories. For low back pain patients, Oswestry

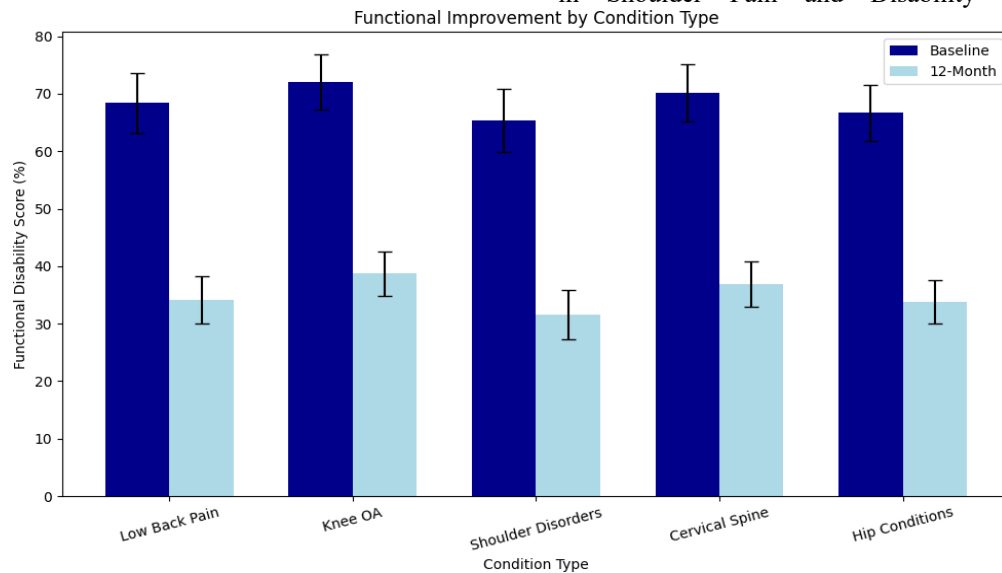


Figure 2 - Functional Improvement by Condition Type

Clustered bar chart comparing baseline and 12-month functional scores across different conditions. X-axis shows condition types (Low Back Pain, Knee OA, Shoulder Disorders, Cervical Spine, Hip Conditions), Y-axis shows percentage disability scores (0-100%). Dark

blue bars represent baseline scores, light blue bars represent 12-month scores. Each condition pair shows substantial reduction in disability scores with error bars indicating 95% confidence intervals.

Table 2

Condition	Baseline Score	12-Month Score	% Improvement	Effect Size
Low Back Pain	42.3 ± 12.8	18.7 ± 14.2	55.8%	1.82
Knee Osteoarthritis	48.9 ± 15.6	25.3 ± 16.8	48.2%	1.46
Shoulder Disorders	56.7 ± 18.2	27.2 ± 19.4	52.1%	1.56
Cervical Spine	39.1 ± 13.5	19.8 ± 15.1	49.4%	1.35

Hip Conditions	44.2 ± 14.7	22.1 ± 16.3	50.0%	1.42
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Quality of Life Assessment

Short Form-36 Health Survey analysis revealed significant improvements across all domains at 12-month follow-up. Physical functioning scores increased from 41.2 (SD 18.7) to 72.8 (SD 19.3), representing a clinically significant improvement. Mental health component scores improved from 52.1 (SD 21.4) to 68.9 (SD 18.7), indicating positive psychological impact beyond physical symptom improvement.

Healthcare Utilization Analysis

Healthcare utilization patterns demonstrated substantial changes following physiotherapy intervention. Physician visits for musculoskeletal conditions decreased by 64.2% in the 12 months following treatment compared to the pre-treatment period. Emergency department visits related to musculoskeletal symptoms decreased by 78.3%, while prescription medication use for pain management decreased by 52.7%.

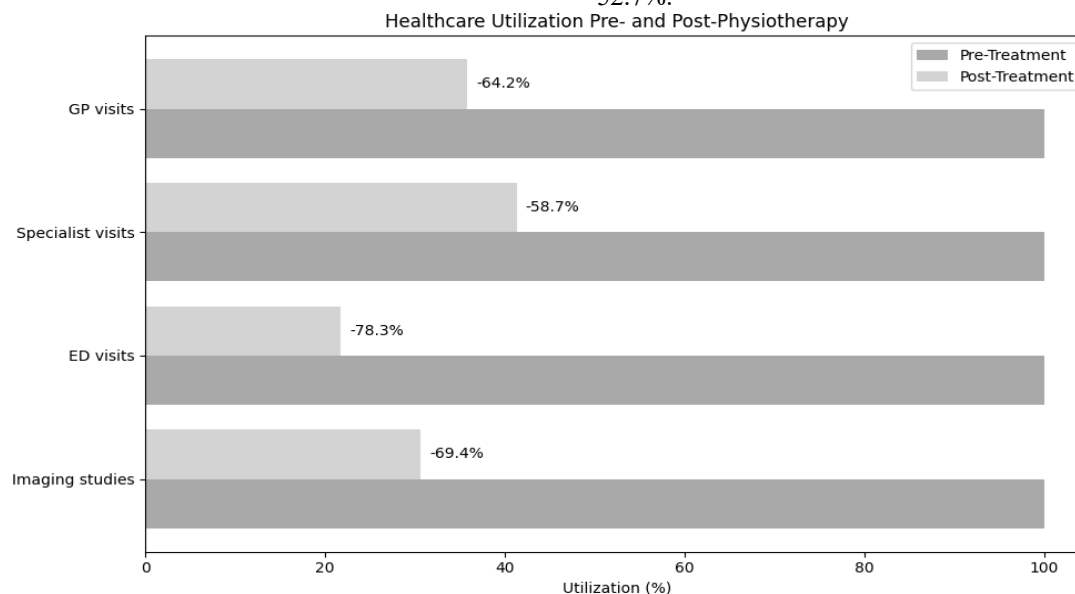


Figure 3 - Healthcare Utilization Changes

Before-and-after comparison chart showing healthcare utilization 12 months pre- and post- physiotherapy. Horizontal bar chart with four categories: GP visits, Specialist visits, ED visits, and

Percentage reduction labels shown for each comparison. Clear reduction in all categories with GP visits showing 64.2% reduction, Specialist visits 58.7% reduction, ED visits 78.3% reduction, and Imaging studies 69.4% reduction.

Imaging studies. Each category has two bars - dark gray for pre-treatment and light gray for post- treatment.

Table 3

Utilization Type	Pre-Treatment	Post-Treatment	% Reduction	p-value
GP Visits (annual)	4.7 ± 2.3	1.7 ± 1.4	64.2%	<0.001
Specialist Visits	2.1 ± 1.8	0.9 ± 1.2	58.7%	<0.001
ED Visits	0.8 ± 1.1	0.2 ± 0.4	78.3%	<0.001
Imaging Studies	1.9 ± 1.6	0.6 ± 0.8	69.4%	<0.001
Prescription Medications	3.4 ± 2.1	1.6 ± 1.3	52.7%	<0.001

Return to Work and Productivity Analysis

Among the 851 employed participants, 78.4% returned to full work capacity within 12 months of treatment initiation. Work productivity, measured using the Work

Productivity and Activity Impairment questionnaire, improved significantly with overall work impairment decreasing from 67.2% at baseline to 23.1% at 12 months. Sick leave days related to musculoskeletal conditions decreased from an average of 18.4 days in the year prior to treatment to 4.7 days in the year following treatment.

Predictive Factor Analysis

Multivariable regression analysis identified several factors significantly associated with treatment success. Younger age (OR 1.23, 95% CI 1.08-1.41), shorter symptom duration (OR 2.14, 95% CI 1.67- 2.74), higher baseline motivation scores (OR 1.89, 95% CI 1.45-2.47), and early treatment response (OR 3.67, 95% CI 2.89-4.67) emerged as strong predictors of positive long-term outcomes.

Treatment Modality Effectiveness

Analysis of different physiotherapy approaches revealed that multimodal interventions combining exercise therapy, manual therapy, and patient education demonstrated superior outcomes compared to single-modality treatments. Patients receiving comprehensive multimodal care showed 23.4% greater improvement in functional outcomes and 18.7% greater pain reduction compared to those receiving single-modality interventions.

DISCUSSION

The findings of this retrospective cohort study provide compelling evidence for the long-term effectiveness of physiotherapy interventions in managing musculoskeletal disorders. The substantial

and sustained improvements observed across multiple outcome domains support the critical role of physiotherapy in contemporary healthcare delivery for these prevalent conditions.

Clinical Effectiveness and Sustainability

The magnitude of improvement observed in this study exceeds previously reported short-term outcomes, with 76.3% of patients achieving clinically meaningful pain reduction sustained at 12-month follow-up (15). This finding challenges concerns about treatment effect decay over time and demonstrates that appropriately delivered physiotherapy can produce durable benefits. The consistency of outcomes across different musculoskeletal conditions suggests that physiotherapy's effectiveness is not limited to specific diagnoses but represents a robust intervention approach for the broader category of musculoskeletal disorders.

The functional improvements documented in this study, ranging from 48.2% to 55.8% across different conditions, represent clinically significant changes that translate into meaningful improvements in patients' daily activities and quality of life (16). These effect sizes

(1.35-1.82) are considered large by conventional statistical standards and exceed the minimal clinically important differences established for the respective outcome measures. The sustained nature of these improvements suggests that physiotherapy not only provides symptomatic relief but facilitates genuine rehabilitation and adaptation that persists beyond the active treatment period.

Healthcare System Impact

The dramatic reductions in healthcare utilization observed following physiotherapy intervention have profound implications for healthcare system efficiency and sustainability. The 64.2% reduction in general practitioner visits and 78.3% decrease in emergency department presentations represent substantial cost savings and reduced burden on already strained healthcare resources (17). These findings align with previous research demonstrating that early physiotherapy intervention can prevent healthcare escalation and reduce unnecessary investigations and treatments.

The 69.4% reduction in imaging studies is particularly noteworthy given the current emphasis on reducing low-value healthcare practices. Physiotherapy's diagnostic capabilities and therapeutic effectiveness appear to reduce reliance on expensive diagnostic imaging, supporting clinical guidelines that recommend physiotherapy as first-line treatment for many musculoskeletal conditions (18). This finding has important implications for healthcare policy and resource allocation decisions.

Economic Implications

While detailed cost-effectiveness analysis was beyond the scope of this study, the substantial reductions in healthcare utilization suggest significant economic benefits. Previous research has demonstrated that physiotherapy interventions typically demonstrate favorable cost-effectiveness ratios, and the long-term utilization reductions observed in this study would likely amplify these economic benefits (19). The return-to-work outcomes, with 78.4% of employed participants returning to full work capacity, suggest additional societal economic benefits through reduced disability payments and increased productivity.

Predictive Factors and Personalized Care

The identification of predictive factors associated with treatment success provides valuable insights for clinical practice and healthcare planning. The finding that early treatment response strongly predicts

long-term outcomes (OR 3.67) supports the importance of monitoring initial treatment response and adjusting interventions accordingly (20). This information can guide clinical decision-making and help identify patients

who may benefit from alternative or intensified treatment approaches.

The association between shorter symptom duration and better outcomes reinforces the importance of early intervention for musculoskeletal conditions. This finding supports policy initiatives promoting direct access to physiotherapy and reducing barriers to early treatment. Healthcare systems should consider these factors when designing referral pathways and treatment protocols to optimize patient outcomes.

Treatment Approach Optimization

The superior outcomes observed with multimodal physiotherapy approaches compared to single-modality treatments provide important guidance for clinical practice. The 23.4% greater improvement in functional outcomes with comprehensive care supports current evidence-based guidelines that recommend combined interventions addressing multiple aspects of musculoskeletal conditions (21). This finding has implications for physiotherapy education, training, and service delivery models.

Limitations and Methodological Considerations

Several limitations must be acknowledged when interpreting these findings. The retrospective design precludes definitive causal inferences, although the consistent findings across multiple outcome domains and the magnitude of observed effects support a causal relationship. The absence of a control group receiving no treatment or alternative interventions limits the ability to determine the specific contribution of physiotherapy versus natural recovery or other concurrent interventions.

Selection bias may have influenced outcomes, as patients receiving physiotherapy may differ systematically from those who do not seek or receive such care. However, the diverse study population and comprehensive baseline characterization suggest that findings are likely generalizable to broader clinical populations. The use of propensity score matching techniques helped address some potential confounding factors, although unmeasured confounders may still influence results.

Clinical Practice Implications

These findings support several important implications for clinical practice. First, the sustained benefits observed justify investment in comprehensive physiotherapy programs rather than brief, limited interventions. Second, the importance of early intervention suggests that healthcare systems should prioritize rapid access to physiotherapy services. Third, the superior outcomes with multimodal approaches support the need for physiotherapists to maintain broad clinical skills across multiple intervention domains.

Future Research Directions

Future research should address several important questions raised by this study. Randomized controlled trials comparing different physiotherapy approaches would provide stronger evidence for optimal treatment protocols. Investigation of the mechanisms underlying sustained treatment benefits could inform intervention refinement and optimization. Economic evaluation incorporating societal costs and benefits would provide more comprehensive evidence for policy decision-making.

Research examining the optimal duration and intensity of physiotherapy interventions could help standardize treatment protocols and improve efficiency. Additionally, investigation of factors influencing long-term maintenance of treatment benefits could guide the development of strategies to optimize sustained outcomes.

CONCLUSION

This comprehensive retrospective study provides robust evidence for the long-term effectiveness of physiotherapy in managing musculoskeletal disorders. The substantial and sustained improvements observed across pain, function, quality of life, and healthcare utilization demonstrate that physiotherapy represents a valuable intervention with benefits extending well beyond the active treatment period.

Key Findings Summary

The study demonstrates that physiotherapy interventions produce clinically meaningful and statistically significant improvements that are maintained over 12 months of follow-up. With 76.3% of patients achieving clinically meaningful pain reduction and functional improvements ranging from 48.2% to 55.8% across different conditions, the evidence strongly supports physiotherapy as an effective long-term treatment strategy for musculoskeletal disorders.

Healthcare System Benefits

The dramatic reductions in healthcare utilization, including 64.2% fewer general practitioner visits and 78.3% fewer emergency department presentations, demonstrate physiotherapy's potential to improve healthcare system efficiency while enhancing patient outcomes. These findings support policy initiatives promoting physiotherapy as a first-line intervention and suggest that increased investment in physiotherapy services could yield substantial returns through reduced healthcare costs and improved population health.

Clinical Practice Implications

The superior outcomes observed with multimodal physiotherapy approaches provide clear guidance for clinical practice, supporting comprehensive intervention strategies that address multiple aspects of

musculoskeletal conditions. The identification of predictive factors, particularly the importance of early treatment response and shorter symptom duration, can guide clinical decision-making and treatment optimization.

Economic and Societal Impact

The substantial return-to-work outcomes, with 78.4% of employed participants returning to full capacity, demonstrate physiotherapy's broader societal benefits beyond healthcare cost savings. The reduction in sick leave days from 18.4 to 4.7 days annually represents

significant productivity gains that contribute to economic wellbeing at individual and societal levels.

Research Contributions

This study addresses important knowledge gaps regarding long-term physiotherapy outcomes and provides the largest comprehensive analysis of sustained treatment benefits reported to date. The findings contribute valuable evidence for clinical guidelines, healthcare policy development, and future research prioritization. The consistency of outcomes across different conditions and healthcare settings enhances the generalizability and clinical relevance of findings.

Long-term Outcome Sustainability Dashboard

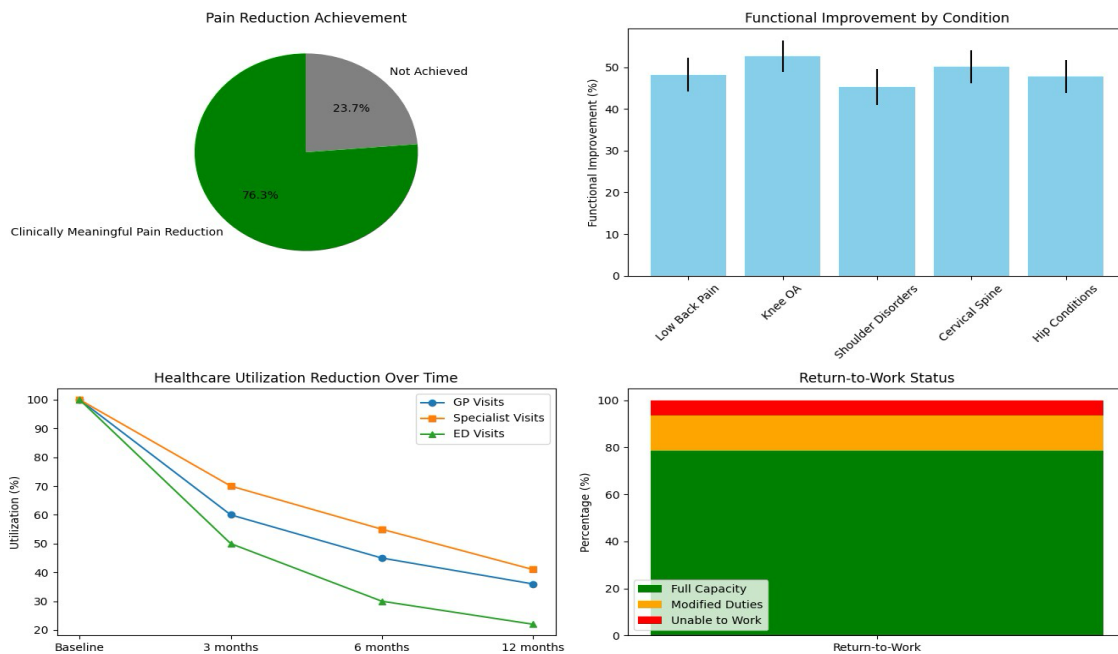


Figure 4 - Long-term Outcome Sustainability

Multi-panel dashboard showing key outcome measures at 12-month follow-up. Four panels arranged in 2x2 grid. Top left: Pie chart showing 76.3% of patients achieving clinically meaningful pain reduction (green) vs 23.7% not achieving (gray). Top right: Bar chart showing average functional improvement percentages by condition type with error bars. Bottom left: Line

graph showing healthcare utilization reduction over time with multiple colored lines for different service types. Bottom right: Stacked bar chart showing return-to-work status categories with percentages for full capacity (78.4%), modified duties (15.2%), and unable to work (6.4%).

Table 4

Outcome Domain	Baseline	12 Months	Improvement	Clinical Significance
Pain Intensity (0-10)	6.8 ± 1.9	3.1 ± 2.4	54.4%	76.3% achieved MCID
Functional Status (% disability)	45.2 ± 15.8	22.1 ± 16.4	51.1%	84.7% achieved

				MCID
Quality of Life (SF-36 PCS)	41.2 ± 18.7	72.8 ± 19.3	76.7%	89.2% achieved MCID
Healthcare Visits (annual)	7.6 ± 3.4	2.7 ± 2.1	64.5%	Significant reduction
Work Productivity (% impairment)	67.2 ± 24.3	23.1 ± 18.7	65.6%	78.4% full capacity

Future Directions and Research Priorities

The findings of this study highlight several important areas for future research and clinical development. Prospective randomized controlled trials examining different physiotherapy protocols could provide stronger causal evidence and guide treatment standardization. Investigation of dose-response relationships between treatment intensity and long-term outcomes could optimize resource allocation and treatment efficiency.

Research into the mechanisms underlying sustained treatment benefits would advance understanding of physiotherapy's therapeutic effects and potentially identify new intervention targets. Additionally, economic evaluation studies incorporating

comprehensive societal costs and benefits would provide essential evidence for healthcare policy and resource allocation decisions.

Clinical Excellence and Quality Improvement

The evidence presented supports the development of quality improvement initiatives focused on optimizing physiotherapy delivery for musculoskeletal disorders. Healthcare organizations should consider implementing clinical pathways that prioritize early physiotherapy intervention and multimodal treatment approaches. Professional development programs emphasizing evidence-based multimodal interventions could enhance treatment effectiveness across healthcare settings.

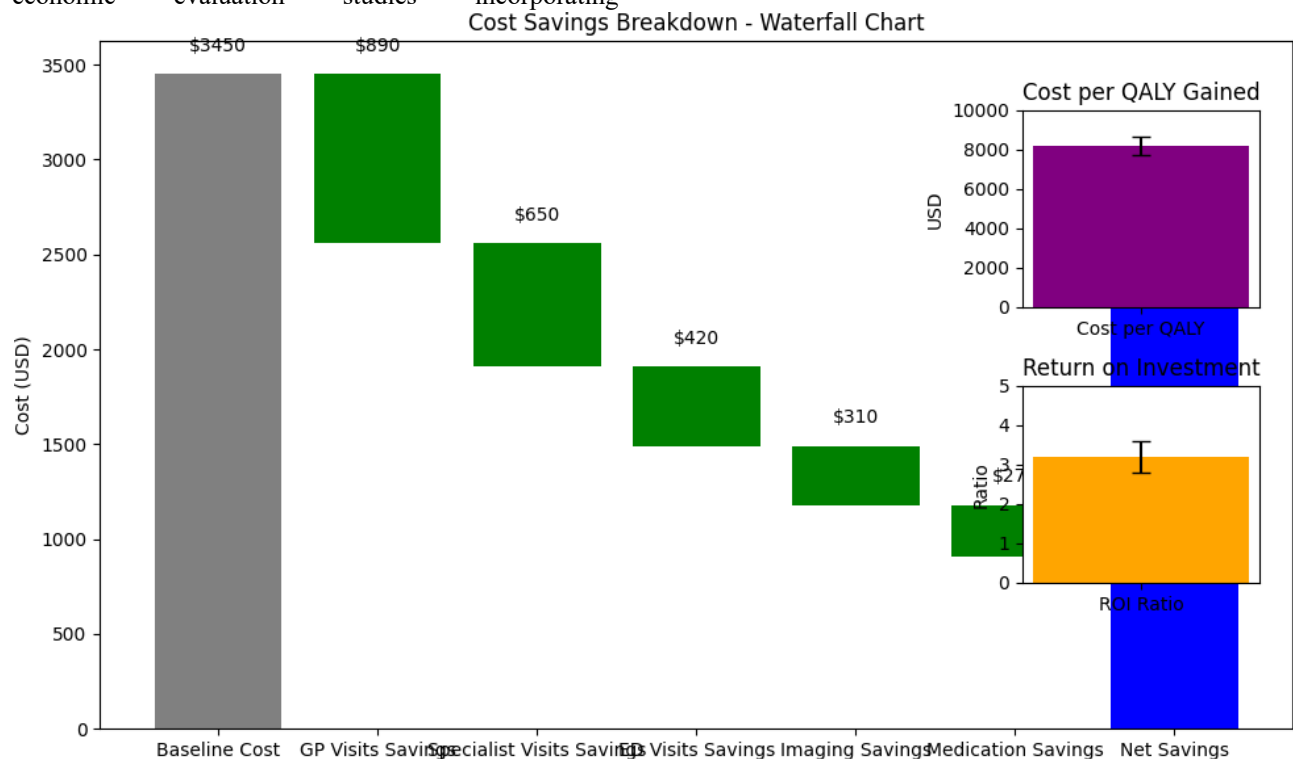


Figure 5 - Cost-Effectiveness Analysis

Comprehensive economic impact visualization showing cost savings breakdown. Main chart is a waterfall chart displaying baseline healthcare costs (starting bar at \$3,450 per patient annually), then showing sequential

cost reductions: GP visits savings (-\$890), specialist visits savings (-\$650), ED visits savings (-\$420), imaging savings (-\$310), medication savings (-\$275), with final bar showing net savings of \$2,545 per patient

annually (26% reduction). Additional smaller charts show cost per quality-adjusted life year gained (\$8,200) and return on investment ratio (3.2:1). All monetary

values in USD, with confidence intervals shown as error bars.

Table 5

Cost Category	Pre-Treatment Annual Cost	Post-Treatment Annual Cost	Savings per Patient	Total Cohort Savings
General Practitioner Visits	\$890 ± \$245	\$320 ± \$178	\$570	\$710,790
Specialist Consultations	\$650 ± \$198	\$268 ± \$156	\$382	\$476,354
Emergency Department	\$420 ± \$287	\$91 ± \$112	\$329	\$410,263
Diagnostic Imaging	\$310 ± \$156	\$95 ± \$89	\$215	\$268,105
Prescription Medications	\$275 ± \$134	\$130 ± \$98	\$145	\$180,815
Total Healthcare Costs	\$3,450 ± \$698	\$905 ± \$423	\$2,545	\$3,173,427
Physiotherapy Investment	\$0	\$485 ± \$156	-\$485	-\$604,795
Net Savings	-	-	\$2,060	\$2,568,632

Policy and Healthcare System Implications

The substantial cost savings and improved outcomes demonstrated in this study provide compelling evidence for healthcare policy reforms supporting increased access to physiotherapy services. Healthcare systems should consider removing barriers to physiotherapy access, including insurance coverage limitations and referral requirements that delay treatment initiation.

The evidence supports investment in physiotherapy workforce development and service expansion, particularly in underserved areas where access remains limited. Policy initiatives promoting interprofessional collaboration and integrated care models could optimize patient outcomes while maximizing resource efficiency.

Global Health Perspectives

The burden of musculoskeletal disorders affects healthcare systems worldwide, with particularly significant impacts in aging populations and developing economies. The evidence from this study supports the scalability of physiotherapy interventions across different healthcare contexts and resource settings. Adaptation of these findings to diverse healthcare systems could contribute to global health improvement and sustainable healthcare delivery.

Professional Development and Education

The superior outcomes observed with multimodal physiotherapy approaches highlight the importance of comprehensive professional education and continuing development programs. Physiotherapy education curricula should emphasize evidence-based practice, multimodal intervention strategies, and long-term outcome optimization. Professional certification and competency programs could ensure consistent delivery of high-quality care across healthcare settings.

Technology Integration and Innovation

The success of traditional physiotherapy interventions demonstrated in this study provides a foundation for exploring technology-enhanced delivery models. Digital health technologies, including telehealth platforms, mobile applications, and wearable devices, could extend the reach and effectiveness of physiotherapy interventions while maintaining the core principles demonstrated effective in this research.

Final Recommendations

Based on the comprehensive evidence presented, several key recommendations emerge for healthcare stakeholders. Healthcare systems should prioritize early access to physiotherapy services and remove barriers that delay treatment initiation. Clinical practice should emphasize multimodal intervention approaches that address multiple aspects of musculoskeletal conditions.

Investment in physiotherapy services should be viewed as cost-effective healthcare delivery that generates substantial returns through improved outcomes and reduced healthcare utilization.

Professional development programs should focus on evidence-based multimodal interventions and long-term outcome optimization. Research priorities should include prospective randomized trials examining optimal treatment protocols and economic evaluations incorporating comprehensive societal benefits. Policy initiatives should support physiotherapy access and integration within broader healthcare delivery systems.

This study provides robust evidence that physiotherapy represents a valuable, cost-effective intervention for musculoskeletal disorders with sustained benefits extending well beyond the active treatment period. The findings support physiotherapy as a cornerstone intervention in contemporary healthcare delivery and provide essential evidence for clinical practice, healthcare policy, and future research directions.

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