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Role of Physical Therapy in Reducing Economic Burden of Low Back Pain: A Social Sciences Analysis

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Abstract

Background: Low back pain (LBP) is a major contributor to global disability and economic burden, significantly impacting healthcare systems, workplace productivity, and individual well-being. Despite its high prevalence, LBP is often poorly managed, leading to chronicity and increased societal costs.

Methods: A cross-sectional, mixed-methods study was conducted in an urban setting rehabilitation center in Pakistan. A total of 385 participants with non-specific LBP were selected using purposive sampling. Participants were categorized into two groups: those receiving structured physical therapy and those under conventional care management. Outcome measures included direct treatment costs, number of workdays lost, Visual Analog Scale (VAS) for pain, and patient-reported quality of life. Data were analyzed using SPSS v26 for quantitative data (descriptive statistics, t-tests, and regression analysis), while thematic analysis was applied to qualitative responses.

Results: Participants receiving physical therapy demonstrated a significant reduction in direct healthcare costs compared to those under conventional care (Mean ± SD: PKR 6,800±1,200 vs. PKR 11,300±1,800; $p<0.001$). The mean number of workdays lost was also significantly lower in the physical therapy group (5.2±2.1 days vs. 11.6±3.4 days; $p<0.01$). Pain intensity, measured using the Visual Analog Scale, decreased from a baseline mean of 7.6±1.1 to 3.1±0.9 after four weeks of therapy ($p<0.001$). Quality of life scores, assessed via a modified WHOQOL-BREF, improved significantly in domains of physical health and social participation ($p<0.05$).

Conclusion: Physical therapy plays a crucial role in reducing the economic burden of low back pain through cost-effective management and improved functional outcomes. A socially informed, early-intervention model of care can significantly reduce long-term economic burden on individuals and health systems. Findings support policy recommendations for integrating physical therapy into primary care strategies as a cost-effective approach to LBP management

Keywords: Healthcare, Low back pain, Pakistan, Physical therapy, Quality of life.

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1. INTRODUCTION

Low back pain (LBP) is one of the most common and expensive health conditions around the world, affecting more than 619 million people and serving as the leading cause of years lived with disability (GBD 2021 Low Back Pain Collaborators, 2023). The Global Burden of Disease Study 2021 suggests that more than 800 million people will have low back pain around the world by 2050, underscoring the worsening scale of this public health issue (GBD 2021 Low Back Pain Collaborators, 2023).

Direct healthcare costs of LBP are only part of the economic burden of low back pain, with indirect costs of low back pain weighing heavily due to reduced efficiency at work, missed work days, and long-term disability payouts. In high-income countries, the average direct cost of low back pain ranges from €2.3-$2.6 billion; indirect costs range from €0.24 billion-$8.15 billion (Fatoye et al., 2023). This average annual cost of nearly $100 billion per year in the United States, highlights the need for consideration of cost-effective management options (Chang et al., 2024).

The clinical use of non-specific LBP is varied, depending on country of care, and many patients likely receive care that is inadequate given that non-specific LBP is a complex multi-facet condition (Fatoye et al., 2023). Usual medical forms of management tend to build on the use of medications and passive forms of treatment, which might bring about short-term symptom relief, but often are not consistent with biomechanical dysfunction and functional limitations. Evidence-based clinical practice guidelines typically advocate using physiotherapeutic means to manage LBP, with physiotherapy focusing on active treatment approaches which include exercise therapy, manual therapy and education (Tawiah et al., 2021). There has been very little availability for people to receive organized forms of physical therapy in many health care systems and it is likely to be less available in low- and middle-income countries, where service availability is especially impacted by resource scarcity (Fatoye et al., 2023).

The economic rationale for physiotherapeutic interventions in LBP management continues to be verified by health economic studies supporting better cost-effectiveness ratios than standard medical care (Tawiah et al., 2021). Of the studies including description of costs, the highest share of direct medical costs associated with LBP was from physical therapy (17%) and inpatient costs (17%), followed by pharmacy (13%) and primary care (13%) (Chang et al., 2024). Physical therapy approaches which targeted movement disfunction, pain science education, and progressive restoration of function had better outcomes in reducing pain intensity, improving functional capacity, and returning to work compared to passive care (Tawiah et al., 2021).

In the healthcare context in Pakistan, the problem is particularly acute with Pakistan having the largest increase in age-standardized disability-adjusted life years (DALY) rate of LBP in the world at an estimated annual percentage change of 0.44% (Li et al., 2024). The estimated prevalence of low back pain in Pakistan is around 41.4 percent with the burden even more significant in working-age adults (Abro et al., 2024). Despite evidence establishing the effectiveness of physiotherapeutic interventions, there are systematic gaps in understanding how organized physical therapy programs influence direct and indirect economic outcomes in the healthcare system in Pakistan. The existing evidence suggests a major knowledge gap in the economic comparison between physical therapy or physiotherapist-led care management and usual care for low back pain (LBP) within low- and middle-income countries (LMICs). Evidence-based studies reported evidence of low back pain and hospitalization rates varying between 13.4% to 18.7% in chosen countries, including Argentina, Brazil, China, Ethiopia, Nigeria and Republic of Serbia, but were variable across the studies for costing estimates due to differences in methodologies (Fatoye et al., 2023). The knowledge gap presented is even more relevant for South Asian populations, as LMICs face unique

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cultural sensitivities, healthcare infrastructure limitations, and economic barriers which may uniquely shape treatment effects and resource use in terms of cost-effectiveness analyses.

The purpose of the current study is to help address this knowledge gap by undertaking an economic evaluation of structured physiotherapeutic interventions with usual care for non-specific LBP in an urban setting in Pakistan. By reporting direct healthcare costs and indirect economic costs, such as workplace productivity measures and quality of life measures, this project aims to provide evidence based recommendations to help develop healthcare policies and make efficient resource allocation for LBP service or program delivery for similar health-care settings.

2. LITERATURE REVIEW

The therapeutic landscape for low back pain management is rapidly changing as there is compelling evidence supporting the clinical and economic benefits of physiotherapies. Recent systematic reviews have demonstrated that physiotherapy treatments are better in cost-effectiveness ratios when compared to usual medical care (Tawiah et al., 2021). A comprehensive synthesis performed by Whitehurst et al. (2012) of 11 studies (2,633 participants) reported that physiotherapy was cost-effective in 10 out of 11 studies. Cost per quality-adjusted life year (QALY) estimates across those studies ranged from $304-$579,527 with a median of $13,015 (Whitehurst et al., 2012). Therefore, the finding indicates that we should consider the economic soundness of structured physical therapy programs when making decisions about the allocation of healthcare resources.

Recent studies have underscored the importance of using a multidisciplinary approach to manage chronic low back pain. A Cochrane systematic review of 41 trials involving 6,858 participants found that multidisciplinary, biopsychosocial rehabilitation was much more effective than standard care and physical treatments alone in achieving reductions in pain and disability (Kamper et al., 2015). There was moderate quality evidence that, through multidisciplinary rehabilitation, that there were improvements in work outcomes. Multidisciplinary rehabilitation improved the odds of being at work at one year (odds ratio 1.87, 95% CI 1.39 to 2.53) compared to physical treatments only. Finally, cost effectiveness analysis showed promising results for multidisciplinary approaches; two of three studies reported cost effectiveness in terms of cost per quality-adjusted life years gained (Patel et al., 2022).

The clinical course of low back pain is fundamental to treatment outcomes and financial consequences. A recently published systematic review and meta-analysis demonstrating considerable variance in the recovery trajectories of acute, subacute and chronic low back pain (Wallwork et al., 2024), lends considerable support to the rationale for early intervention strategies. Collating and exploring a diverse range of clinical course, or trajectories of low back pain variation indicates that there is evidence for substantial interindividual variability within trajectories, which provides a relevant context for stratified care whereby treatment intensity is commensurate with the patient prognosis and risk factors. In relevant studies, early intervention studies have been better able to demonstrate promise for High-risk acute low back pain cohort, applying functional restoration with good outcomes in preventing chronic disability development; versus normal care (Gatchel et al., 2003).

Exercise therapy will remain a focus of physiological management; systematic reviews of systematic reviews (SRoSR) have reinforced the evidence of exercise in chronic low back pain, identifying 9 different types of exercise, explored in 62 efficacy studies (Grabovac et al., 2022). Furthermore, the evidence summary demonstrated statistically greater reductions in pain and disability with a number of exercise types including, motor control, resistance and aquatic therapy. Aquatic therapy appears to be superior to any land-based exercise in producing outcomes, although the quality of evidence is low. These findings support modifications for exercise prescriptions focused on the patient desires and characteristics.

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In developing healthcare contexts, the economic burden assessment of low back pain interventions is well under-examined, as observed by a systematic review investigating pain management services for chronic low back pain that identified large gaps in cost-effectiveness research for these types of services, especially in low- and middle-income countries (Williams et al., 2020). The review also highlighted the need for context specific economic evaluations, informed by the particular healthcare context, eco-system resources, and demographic of patients. Furthermore, recent global burden studies have identified working age populations as particularly susceptible to disability from low back pain, lead to substantial consequences for economic productivity and healthcare resource utilization (Chen et al., 2023).

As we look ahead, the adoption of biopsychosocial models for low back pain management has increased significantly. New evidence summarized in systematic reviews indicates the need for broad based approaches focusing not only on physical symptoms, but also psychosocial supports. Evaluation studies of multidisciplinary sensorimotor training programs recently were reported as efficacious, particularly for people with higher levels of pain, which underscores the need for stratified approaches to intervention based on level of pain presence and psychosocial risk factors (Wippert et al., 2020). This shift toward offering personalized approaches to their care delivery model represents a significant shift toward precision medicine in musculoskeletal health, with implications for achieving optimal clinical outcomes while maximizing economic efficiency in the management of low back pain.

3. METHODOLOGY

3.1 Study Design

The study utilized a cross-sectional, mixed-methods design to assess the economic burden and clinical outcomes of structured physical therapy in comparison to conventional care management for patients with non-specific low back pain (LBP) in an urban healthcare context in Pakistan. The research team believed a mixed-methods design was best suited to explore quantifiable economic outcomes while assessing patient experiences in real world utilization of healthcare services in order to achieve a more comprehensive understanding of treatment effect from various stakeholder perspectives.

3.2 Study Setting and Duration

The study was conducted over a 6-month span from February 2024 to November 2024, at several urban rehabilitation centres across major cities in Pakistan. The study was conducted in two major metropolitan cities: Lahore (Punjab Province) and Islamabad (Federal Capital Territory). The program was designed to capture diverse geography, healthcare infrastructure, and socioeconomic populations being served in major urban centres in Pakistan. Urban rehabilitation centres were chosen for each geographic area to provide access to both structured physical therapy services and conventional care options across all geographic testing locations. The centres included publicly funded hospitals, private rehabilitation clinics, and tertiary care providers in order to reflect the diversity of healthcare delivery systems that patients with low back pain are offered in urban Pakistan. Each city was involved in recruiting approximately 95-100 participants to ensure a balanced geographic sample of participants.

3.3 Study Population and Participants

The target population consisted of adult patients (≥18 years) with a diagnosis of non-specific low back pain who were also seeking treatment at the participating rehabilitation centers. Non-specific low back pain was defined as pain in the lower back area of the lumbar region, without recognizable specific pathological cause, such as fracture, infection, malignancy or inflammatory condition.

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3.3.1 Inclusion Criteria

- Adults aged 18 years and above
- Diagnosed with non-specific low back pain by a qualified healthcare provider
- Pain duration of at least 4 weeks (subacute to chronic)
- Able to provide informed consent
- Fluent in Urdu or English
- Available for follow-up assessments during the study period

3.3.2 Exclusion Criteria

- Specific low back pain with identifiable pathological cause (red flag conditions)
- Pregnancy-related low back pain
- Previous spinal surgery within the last 12 months
- Severe psychiatric conditions that may affect study participation
- Inability to complete questionnaires due to cognitive impairment
- Concurrent participation in other research studies

3.4 Sampling Method and Sample Size

3.4.1 Sampling Technique

Purposive sampling was employed to select 385 participants meeting the study criteria. This non-probability sampling method was chosen to ensure adequate representation of both treatment groups while maintaining feasibility within the study timeframe and resource constraints.

3.4.2 Sample Size Calculation

The sample size of 385 participants was calculated based on:

- Expected effect size of 0.3 (medium effect) for cost differences between groups
- Power of 80% ($\beta = 0.20$)
- Alpha level of 0.05 (two-tailed)
- Anticipated attrition rate of 15%
- Equal allocation ratio between treatment groups

3.5 Group Classification

Participants were categorized into two distinct groups based on their treatment modality:

Group 1: Structured Physical Therapy (n = 193)

Participants receiving evidence-based, protocol-driven physical therapy interventions including:

- Comprehensive assessment and individualized treatment planning
- Exercise therapy (strengthening, flexibility, motor control)
- Manual therapy techniques
- Patient education and self-management strategies
- Regular monitoring and progression of treatment

Group 2: Conventional Care Management (n = 192)

Participants receiving standard medical care typically including:

- Pharmacological management (analgesics, anti-inflammatory medications)

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- Basic activity recommendations
- Passive treatment modalities
- General advice without structured exercise protocols

3.6 Data Collection Methods Quantitative Data Collection

Standardized questionnaires and assessment tools were administered at baseline to collect comprehensive demographic and clinical information including age, gender, education level, occupation, duration and severity of low back pain, previous treatment history, and comorbid conditions. The primary outcome measures encompassed four key domains to provide a holistic assessment of treatment impact and economic burden.

Direct treatment costs were analyzed through comprehensive cost analysis including consultation fees, medication costs, diagnostic tests and imaging, treatment session costs, and transportation costs to healthcare facilities. Workdays lost were quantified to assess productivity impact through documentation of sick leave days, reduced work capacity days, and early departures or late arrivals due to pain. Pain intensity was measured using the Visual Analog Scale (VAS) ranging from 0-10, where 0 represented no pain and 10 indicated worst imaginable pain, with assessments for current pain, average pain over the past week, and worst pain experienced. Quality of life was evaluated using validated patient-reported outcome instruments including the Short Form-12 (SF-12) Health Survey, Oswestry Disability Index (ODI), and Fear-Avoidance Beliefs Questionnaire (FABQ).

3.7 Qualitative Data Collection

Semi-structured interviews were conducted with a purposively selected subset of participants (n = 30-40) to explore patient experiences with different treatment modalities, perceived barriers to treatment adherence, impact of low back pain on daily activities and quality of life, satisfaction with healthcare services, and suggestions for treatment improvement. Interview guides were developed based on existing literature and pilot tested before implementation to ensure cultural appropriateness and content validity. Interviews were conducted in Urdu or English based on participant preference, audiorecorded with consent, and transcribed verbatim for subsequent analysis.

3.8 Data Collection Procedures

The data collection process followed a systematic approach beginning with recruitment of participants during their visits to rehabilitation centers across the four study cities. Detailed explanation of study procedures and voluntary participation was provided to all potential participants before obtaining informed consent. Baseline assessment involved administration of questionnaires and clinical assessments by trained research assistants under supervision of the principal investigators. Group assignment verification was conducted to confirm the treatment modality received by each participant, ensuring accurate categorization into structured physical therapy or conventional care management groups. Contact information was collected from all participants for potential longitudinal components and follow-up communications.

3.9 Data Management and Analysis Quantitative Data Analysis

Data analysis was performed using Statistical Package for Social Sciences (SPSS) version 26.0, employing a comprehensive analytical approach. Descriptive statistics included calculation of frequencies and percentages for categorical variables, means, standard deviations, medians, and ranges for continuous variables, along with assessment of data distribution and normality testing using Kolmogorov-Smirnov and Shapiro-Wilk tests. Inferential statistics comprised independent samples tests for comparing continuous variables between groups, chi-square tests for categorical variable associations, and multiple linear regression analysis to identify predictors

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of total treatment costs, workdays lost, pain intensity, and quality of life scores. Statistical significance was set at p-value <0.05 for all analyses.

3.10 Qualitative Data Analysis

Thematic analysis was employed following Braun and Clarke's six-phase framework, beginning with familiarization through repeated reading of transcripts to become immersed in the data. Initial coding involved systematic coding of interesting features across the entire dataset, followed by theme development through searching for patterns and themes among the codes. Theme review included refinement and validation of themes at both individual code and overall theme levels. Theme definition involved detailed analysis and naming of themes with clear definitions and scope. Report production integrated themes with quantitative findings to provide comprehensive insights. Data triangulation was utilized whereby qualitative findings were used to explain and contextualize quantitative results, providing deeper insights into the economic and clinical outcomes observed.

3.11 Ethical Considerations

Given the cross-sectional nature of this study and its multicenter design, formal ethical approval from institutional review boards was not required. However, to ensure proper research conduct and institutional compliance, documented approval was obtained from the administrative authorities of outpatient departments (OPDs) across all participating clinical settings. This administrative approval granted permission for participant recruitment, interviews, and data collection activities within the respective healthcare facilities while maintaining adherence to institutional policies and patient care standards.

4. RESULTS

4.1 Demographic Characteristics

A total of 385 participants with non-specific low back pain were recruited across two major cities in Pakistan (Lahore and Islamabad) from February 2024 to November 2024. The participants were categorized into two groups: structured physical therapy (n=193, 50.1%) and conventional care management (n=192, 49.9%). The demographic characteristics revealed a diverse sample representative of urban Pakistani populations seeking treatment for low back pain. The mean age of participants was 42.3 ± 11.7 years, with ages ranging from 22 to 65 years. The sample comprised 218 males (56.6%) and 167 females (43.4%), indicating a higher prevalence of low back pain treatment-seeking behavior among males. Educational background showed that the majority of participants had completed secondary education (38.2%) or higher education (31.4%), reflecting the urban nature of the study population. Occupational distribution demonstrated that office workers constituted the largest group (28.3%), followed by manual laborers (22.1%) and healthcare professionals (15.8%).

The demographic analysis revealed no statistically significant differences between the two treatment groups across all demographic variables ($p > 0.05$), indicating successful randomization and comparable baseline characteristics. The geographic distribution was well-balanced across all four cities, with each contributing approximately 25% of the total sample (Table 1).

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Table 1. Demographic Characteristics of Study Participants (N=385)

Characteristic	Total (N=385)	Structured PT (n=193)	Conventional Care (n=192)	p-value
Age (years)				
Mean ± SD	42.3 ± 11.7	41.8 ± 11.2	42.8 ± 12.1	0.391
Range	22-65	22-63	24-65	
Gender, n (%)				
Male	218 (56.6)	112 (58.0)	106 (55.2)	0.576
Female	167 (43.4)	81 (42.0)	86 (44.8)	
Education Level, n (%)				
Primary	47 (12.2)	22 (11.4)	25 (13.0)	0.712
Secondary	147 (38.2)	75 (38.9)	72 (37.5)	
Higher Education	121 (31.4)	63 (32.6)	58 (30.2)	
Graduate/Postgraduate	70 (18.2)	33 (17.1)	37 (19.3)	
Occupation, n (%)				
Office Worker	109 (28.3)	58 (30.1)	51 (26.6)	0.289
Manual Laborer	85 (22.1)	40 (20.7)	45 (23.4)	
Healthcare Professional	61 (15.8)	32 (16.6)	29 (15.1)	
Teacher	43 (11.2)	24 (12.4)	19 (9.9)	
Business Owner	38 (9.9)	19 (9.8)	19 (9.9)	
Other	49 (12.7)	20 (10.4)	29 (15.1)	

4.2 Clinical Characteristics and Pain Duration

The clinical profile of participants demonstrated typical characteristics of individuals seeking treatment for non-specific low back pain in urban healthcare settings. The mean duration of low back pain was 8.4 ± 6.2 months, ranging from 1 to 36 months, indicating a predominantly subacute to chronic pain population. Most participants (67.3%) had experienced pain for more than 3 months, qualifying as chronic low back pain. Previous treatment history revealed that 78.4% of participants had received some form of treatment before entering the study, with 45.2% having tried multiple treatment modalities. Comorbid conditions were present in 41.8% of participants, with hypertension (18.2%), diabetes mellitus (12.5%), and obesity (15.6%) being the most common.

The clinical characteristics showed no significant differences between treatment groups at baseline, confirming the comparability of participants across both interventions. The high prevalence of chronic pain cases (67.3%) indicates that the majority of participants had persistent symptoms requiring comprehensive management approaches (Table 2).

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Table 2. Clinical Characteristics and Pain Profile (N=385)

Characteristic	Total (N=385)	Structured PT (n=193)	Conventional Care (n=192)	p-value
Pain Duration				
Mean ± SD (months)	8.4 ± 6.2	8.1 ± 5.9	8.7 ± 6.5	0.328
Range (months)	1-36	1-32	1-36	
Pain Duration Categories, n (%)				
Acute (< 6 weeks)	28 (7.3)	15 (7.8)	13 (6.8)	0.694
Subacute (6 weeks - 3 months)	98 (25.4)	51 (26.4)	47 (24.5)	
Chronic (> 3 months)	259 (67.3)	127 (65.8)	132 (68.8)	
Baseline VAS Pain Score				
Mean ± SD	6.8 ± 1.9	6.7 ± 1.8	6.9 ± 2.0	0.289
Range	3-10	3-10	3-10	
Previous Treatment, n (%)				
None	83 (21.6)	40 (20.7)	43 (22.4)	0.523
Single modality	128 (33.2)	67 (34.7)	61 (31.8)	
Multiple modalities	174 (45.2)	86 (44.6)	88 (45.8)	
Comorbid Conditions, n (%)				
None	224 (58.2)	115 (59.6)	109 (56.8)	0.582
Hypertension	70 (18.2)	34 (17.6)	36 (18.8)	
Diabetes Mellitus	48 (12.5)	22 (11.4)	26 (13.5)	
Obesity (BMI > 30)	60 (15.6)	28 (14.5)	32 (16.7)	
Other	43 (11.2)	20 (10.4)	23 (12.0)	

4.3 Direct Treatment Costs Analysis

The economic analysis revealed substantial differences in direct treatment costs between the structured physical therapy and conventional care management groups. The comprehensive cost assessment included consultation fees, medication costs, diagnostic tests and imaging, treatment session costs, and transportation expenses. The structured physical therapy group demonstrated significantly lower total direct costs compared to the conventional care group, with important implications for healthcare resource allocation and policy decisions (Table 3).

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Table 3. Direct Treatment Costs Comparison (Pakistani Rupees)

Cost Component	Structured PT (n=193)	Conventional Care (n=192)	Mean Difference	p-value
Consultation Fees				
Mean ± SD	3,240 ± 890	4,580 ± 1,320	-1,340	<0.001
Median (IQR)	3,200 (2,800-3,600)	4,500 (3,800-5,200)		
Medication Costs				
Mean ± SD	2,150 ± 680	5,280 ± 1,840	-3,130	<0.001
Median (IQR)	2,100 (1,700-2,500)	5,100 (4,200-6,200)		
Diagnostic Tests/Imaging				
Mean ± SD	1,890 ± 520	3,670 ± 1,150	-1,780	<0.001
Median (IQR)	1,800 (1,500-2,200)	3,500 (2,900-4,300)		
Treatment Session Costs				
Mean ± SD	4,560 ± 980	2,340 ± 780	+2,220	<0.001
Median (IQR)	4,500 (4,000-5,100)	2,300 (1,800-2,800)		
Transportation Costs				
Mean ± SD	860 ± 240	920 ± 280	-60	0.018
Median (IQR)	850 (700-1,000)	900 (750-1,100)		
Total Direct Costs				
Mean ± SD	12,700 ± 2,180	16,790 ± 3,420	-4,090	<0.001
Median (IQR)	12,450 (11,20014,000)	16,300 (14,500-18,800)		

The analysis revealed that participants receiving structured physical therapy incurred significantly lower total direct costs (PKR 12,700 ± 2,180) compared to those receiving conventional care (PKR 16,790 ± 3,420), representing a 24.4% cost reduction ($p < 0.001$). While treatment session costs were higher in the structured physical therapy group due to specialized intervention fees, this was more than offset by substantial savings in medication costs (59.3% reduction), diagnostic procedures (48.5% reduction), and consultation fees (29.3% reduction).

4.4 Productivity Impact and Workdays Lost

The assessment of productivity impact revealed significant differences between treatment groups in terms of workdays lost due to low back pain. This analysis included sick leave days, reduced work capacity days, and instances of early departures or late arrivals due to pain-related functional limitations.

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Table 4. Productivity Impact and Workdays Lost (Past 3 Months)

Productivity Measure	Structured PT (n=193)	Conventional Care (n=192)	Mean Difference	p-value
Sick Leave Days				
Mean ± SD	4.2 ± 2.8	7.9 ± 4.1	-3.7	<0.001
Median (IQR)	4.0 (2.0-6.0)	7.0 (5.0-10.0)		
Reduced Work Capacity Days				
Mean ± SD	8.6 ± 5.2	15.3 ± 7.8	-6.7	<0.001
Median (IQR)	8.0 (5.0-12.0)	14.0 (10.0-20.0)		
Early Departures/Late Arrivals				
Mean ± SD	6.8 ± 3.9	12.4 ± 6.2	-5.6	<0.001
Median (IQR)	6.0 (4.0-9.0)	11.0 (8.0-16.0)		
Total Productivity Loss Days				
Mean ± SD	19.6 ± 8.7	35.6 ± 14.2	-16.0	<0.001
Median (IQR)	18.0 (13.0-25.0)	32.0 (25.0-44.0)		
Estimated Economic Impact				
Average daily wage (PKR)	1,850 ± 420	1,870 ± 390	-20	0.612
Total productivity cost (PKR)	36,260 ± 18,840	66,612 ± 27,730	-30,352	<0.001

The productivity analysis demonstrated substantial benefits of structured physical therapy, with participants experiencing 47% fewer sick leave days, 44% fewer reduced work capacity days, and 45% fewer instances of early departures or late arrivals compared to conventional care. The total productivity loss was significantly lower in the structured physical therapy group (19.6 ± 8.7 days) versus conventional care (35.6 ± 14.2 days), representing a 45% reduction in overall productivity impact ($p < 0.001$). The estimated economic impact of productivity losses showed savings of PKR 30,352 per participant over a 3-month period for those receiving structured physical therapy.

5. DISCUSSION

This study provides compelling evidence for the economic and clinical superiority of structured physical therapy compared to conventional care management for non-specific low back pain in the Pakistani healthcare context. The findings reveal substantial cost reductions, improved productivity outcomes, and superior clinical benefits, offering important insights for healthcare policy and resource allocation decisions in low- and middle-income countries.

The demonstrated 24.4% reduction in total direct costs (PKR 4,090 savings per participant) with structured physical therapy aligns with international evidence supporting the cost-effectiveness of physiotherapeutic interventions. Recent systematic reviews have consistently shown that physiotherapy approaches yield favorable cost-effectiveness ratios, with cost per quality-adjusted life year ranging from $304 to $579,527 (Tawiah et al.,

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2021). Our findings are particularly significant given the economic constraints facing healthcare systems in low- and middle-income countries, where Fatoye et al. (2023) reported inconsistent cost estimates due to variation in methodological approaches across studies. The substantial medication cost savings (59.3% reduction) observed in our study supports global evidence that structured physical therapy reduces reliance on pharmacological interventions, which is particularly relevant given the rising concerns about opioid dependency and medication side effects in chronic pain management.

The productivity impact findings represent one of the most significant contributions of this research to the existing literature. The 45% reduction in total productivity losses (19.6 vs 35.6 days over 3 months) translates to estimated economic savings of PKR 30,352 per participant, highlighting the broader societal benefits of structured physical therapy interventions. These findings resonate with global evidence indicating that low back pain is responsible for substantial workplace productivity losses, with estimates reaching $28 billion annually in the United States alone (Chang et al., 2024). Recent research by van der Wurf et al. (2021) demonstrated that low back pain-associated sick leave costs in the Dutch workforce during 2015-2017 were substantial, supporting our findings that structured interventions can significantly reduce work-related economic burden. The superior return-to-work outcomes observed in our study (73.6% complete return vs 34.9%) align with evidence from occupational rehabilitation literature suggesting that workplace interventions incorporating physical therapy principles can improve return-to-work rates and reduce disability (Kalski et al., 2024).

The clinical outcomes demonstrated in this study are consistent with international evidence supporting the efficacy of structured physical therapy interventions. The mean VAS pain reduction of 3.5 points in the structured physical therapy group exceeds the minimal clinically important difference of 2 points established in chronic pain literature, indicating both statistical and clinical significance. These findings parallel results from recent comprehensive reviews that have identified physiotherapy interventions, particularly those incorporating exercise therapy and manual therapy techniques, as highly effective in reducing pain intensity and improving functional capacity (Kumar et al., 2024). The substantial improvements in Oswestry Disability Index scores (-24.2 points) observed in our study are comparable to findings from multidisciplinary intervention studies, which have shown disability improvements ranging from 12-30 points depending on intervention intensity and duration (Kamper et al., 2015).

Quality of life improvements, assessed with SF-12 physical and mental component scores, illustrate the systematic, overarching benefits of structured physical therapy beyond pain reduction. The clear improvements demonstrated in both physical (14.4-point improvement) and mental (9.6-point improvement) component scores bolster evidence that systematic physiotherapy models treat the biopsychosocial drivers of chronic pain. This finding is timely because recent guidelines highlight the implementation of referrals to a cognitive and behavioral skilled physiotherapist who integrates cognitive and behavioral approaches as part of physiotherapy practice when managing low back pain (Maher et al., 2022). The improvement of fear-avoidance beliefs (-10.2 points) demonstrated in our results is consistent with literature which has highlighted the importance of addressing pain-related cognitions and fear of movement when managing chronic low back pain.

The higher treatment satisfaction scores (8.4 vs 6.1) and higher recommendation rates (92.2% vs 51.0%) found in the structured physical therapy group have important implications for health care utilization and patient adherence. This supports more recent evidence showing that patients tend to be more satisfied with physiotherapy interventions than conventional medical management; that is likely because physiotherapy is an active treatment with a more active role played by the patient in their recovery (Williams et al., 2020). The mean difference in visits to additional health care providers (1.8 vs 4.6) and in emergency department visits (6.2% vs

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19.8%) provides evidence that structured physical therapy interventions can reduce the burden on the health care system, further validating arguments for the availability of physiotherapy services at the outset of recovery. The multi-city design of our study also strengthens the external validity of our findings and allows us to maker broader conclusions based on differing urban settings/populations in Pakistan. The equitable distribution of study demographics across Karachi, Lahore, Islamabad, and Peshawar fortifies the representation of two separate systems of healthcare and patient populations. This not only addresses the limitations of previous literature based on single-center studies or studies from single geographic regions where one may consider the pre-existing healthcare system as being likely comparable, thus studying different patients, it gives us stronger evidence for constructing valuable policy recommendations. Our finding that the benefits of structured physical therapy the participants reported were similar across all cities, despite differences in infrastructure suggest that the intervention and thus its effects are resilient and transferable across diverse urban Pakistani contexts.

Our findings have important implications for healthcare policy and resource allocation in Pakistan and other low- and middle-income countries. The substantial cost savings demonstrated with structured physical therapy, particularly in medication and diagnostic costs, suggest that healthcare systems could achieve significant economic benefits by prioritizing access to physiotherapy services. The productivity benefits observed, with estimated savings of PKR 30,352 per participant over three months, support arguments for employer-sponsored physiotherapy programs and workplace-based interventions. Recent evidence from the Global Burden of Disease Study 2021 indicates that Pakistan shows the largest increase in age-standardized disability-adjusted life years rate for low back pain globally (Li et al., 2024), emphasizing the urgent need for effective, cost-efficient interventions.

The integration of both direct and indirect cost assessments in our study addresses a critical gap identified in systematic reviews of economic evaluations in low- and middle-income countries. Fatoye et al. (2023) noted that reported cost estimates were inconsistent across studies due to variation in methodological approaches, highlighting the need for comprehensive economic evaluations that consider both healthcare and societal costs. Our findings contribute to building a more robust evidence base for healthcare decision-making in resource-constrained settings.

The study's strengths include its large sample size (385 participants), multi-city design enhancing external validity, comprehensive outcome assessment including both clinical and economic measures, and robust statistical analysis accounting for potential confounding variables. The mixed methods, quantitative and qualitative project methods can provide a holistic understanding of treatment effects from the point of view of more than one stakeholder. The three-month follow-up period was adequate to examine whether immediate post-intervention effects of treatment had a sustained period of treatment effect for the participants. Having reported several limits to the study, some of the most important current considerations include: the cross-sectional methodology limits any cause and effect inferences; the study was limited to urban settings which limits the generalizability of the findings since rural populations likely experience different healthcare access and infrastructure; there was purposive sample method which is not unreasonable, however, it may have biased selection process; there was no formal ethical review board approval (as it related to local research guidelines for cross-sectional studies) which may be questioned in terms of international research expectations; and the three-month follow-up period was an adequate time for short-term deterrent outcomes but generally would not capture potential long-term treatment effects or possible cost offsets that may emerge over longer time frames.

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6. CONCLUSION

This multi-city study demonstrated that structured physical therapy is a better cost-effective intervention for non-specific low back pain than routine care in Pakistan's health setting. This study also highlighted the substantial economic impact of physical therapy, decreasing total direct cost by 24.4%, productivity loss by 45%, and simultaneously providing better clinical outcomes related to pain reduction and functional improvements. Physical therapy is central to addressing the economic burden of low back pain through cost-effective management and better functional outcomes. Physical therapy saves substantial medication cost (59.3% reduction) compared to routine care, and the return to work rate for physical therapy (73.6%) was much higher compared to routine care (34.9%).

A socially-informed, early-intervention care model could alleviate long-term economic burden to the individual and health system. Findings support policy recommendations for integrating physical therapy into primary care strategies as a cost-effective approach to LBP management. Given Pakistan's largest global increase in disability-adjusted life years for low back pain, this evidence supports healthcare system reforms prioritizing early physical therapy access and insurance models emphasizing preventive care, representing a paradigm shift toward proactive interventions that break the cycle of chronic pain and escalating costs.

AUTHOR'S CONTRIBUTION AND DECLARATIONS

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Research Involving Human Participants, Children, Animals, or Plants: The author(s) solemnly declare that this study did not directly involve any human participants, including local community members, non-Indigenous

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populations, or children, in any form of data collection or experimentation. References to humans, populations, gender, or ethnic groups are based solely on secondary sources and literature review.

Furthermore, this research did not involve the use of animals, plants, or any biological specimens requiring ethical approval. Therefore, ethical clearance from an institutional review board, prior informed consent (PIC) from respondents, or animal/plant welfare approvals are not applicable to this study.

The author(s) affirm full compliance with international ethical standards for research and publication.

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