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PHYSIOTHERAPY AND ORTHOTIC INTERVENTIONS FOR ENHANCING FUNCTIONAL MOBILITY AND MUSCLE STRENGTH IN LOWER LIMB DISORDERS: A REVIEW OF EVIDENCE FROM PAKISTAN- A SYSTEMATIC REVIEW

Systematic Review

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ABSTRACT

Background: Lower limb disorders are a leading cause of disability in Pakistan, frequently resulting in impaired functional mobility, muscle weakness, and reduced quality of life. The burden is amplified by delayed rehabilitation access and variability in clinical practices across healthcare settings. Although physiotherapy and orthotic interventions are widely used, evidence specific to the Pakistani context remains fragmented, limiting informed decision-making and standardized rehabilitation planning.
Objective: This review aimed to systematically evaluate and synthesize Pakistani evidence on the effectiveness of physiotherapy, orthotic, and combined rehabilitation interventions in improving functional mobility and muscle strength among individuals with lower limb disorders.
Methods: A systematic literature search was conducted in accordance with the PRISMA framework using PubMed, Google Scholar, PakMediNet, and ScienceDirect. Studies published between January 2005 and March 2025 were screened. Eligible studies included randomized controlled trials, quasi-experimental, cohort, and interventional studies conducted in Pakistan involving neurological, musculoskeletal, or metabolic lower limb disorders. Outcomes of interest included functional mobility, muscle strength, gait, balance, and functional independence. Methodological quality was appraised using Critical Appraisal Skills Programme checklists.
Results: Twelve studies met the inclusion criteria, comprising randomized controlled trials (n = 3), quasi-experimental studies (n = 3), and interventional clinical studies (n = 6), with sample sizes ranging from 15 to 120 participants. Physiotherapy-based interventions (n = 7) demonstrated statistically significant improvements in pain and function, including reductions in WOMAC pain scores, improvements in Katz Activities of Daily Living, and faster Timed Up and Go performance, with reported p-values <0.05. Pediatric and neurological studies reported significant gains in Gross Motor Function Measure scores ($p = 0.003$) and reductions in spasticity. Orthotic interventions (n = 5) showed improvements in gait alignment, ankle range of motion, and activities of daily living, though outcomes were inconsistent when orthoses were used in isolation. Combined rehabilitation approaches (n = 6) consistently yielded superior improvements in functional independence, lower extremity function, and quality-of-life measures compared with single-modality interventions.
Conclusion: Physiotherapy emerged as the primary driver of functional recovery in lower limb disorders, while orthotic devices were most effective as adjuncts within integrated rehabilitation programs. Multimodal, context-specific rehabilitation strategies appear essential for optimizing functional mobility and muscle strength in the Pakistani healthcare setting.
Keywords: Functional Mobility, Gait, Lower Limb Disorders, Muscle Strength, Orthotic Devices, Physical Therapy Modalities, Rehabilitation.

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INTRODUCTION

Functional mobility and muscle strength are core determinants of independence, safety, and participation in daily life. Functional mobility encompasses an individual's capacity to stand, walk, transfer, and perform routine activities safely across different environments, while muscle strength reflects the ability of skeletal muscles to generate the force required for movement, balance, and postural control (1). When these capacities are compromised, particularly due to lower limb disorders, individuals experience limitations in activity, reduced social participation, and a decline in quality of life. Lower limb conditions commonly result in weakness, abnormal gait patterns, balance deficits, and functional restrictions, making timely and effective rehabilitation essential to restore function and reduce the risk of long-term disability (2,3). In Pakistan, the burden of lower limb disorders is substantial and multifactorial, arising from a combination of neurological, musculoskeletal, metabolic, and trauma-related causes. Conditions such as stroke, cerebral palsy, post-polio residual paralysis, diabetic neuropathy, osteoarthritis, fractures, and road traffic injuries contribute significantly to lower limb impairment, often affecting individuals during their most productive years (4). The functional consequences of these conditions are frequently intensified by delayed diagnosis, limited access to early rehabilitation services, late referrals, and socioeconomic constraints. As a result, many individuals live with preventable disability, increased dependence on caregivers, and reduced engagement in employment and community life, highlighting a critical need for effective and context-appropriate rehabilitation strategies within the local healthcare system (5). Physiotherapy and orthotic management are widely recognized as central components of lower limb rehabilitation. Physiotherapy interventions—including therapeutic exercises, gait training, balance retraining, and neuromuscular facilitation—aim to enhance muscle strength, coordination, and functional mobility. Orthotic devices, such as ankle-foot orthoses, knee-ankle-foot orthoses, and custom foot orthoses, are designed to improve limb alignment, provide external support, optimize gait efficiency, and reduce compensatory movement patterns (6,7).

When applied individually or in combination, these approaches have the potential to significantly improve functional outcomes. However, their effectiveness is influenced by patient-specific factors, clinical expertise, availability of resources, and healthcare system characteristics that vary across different settings (8). Despite growing international evidence supporting physiotherapy and orthotic interventions for lower limb disorders, Pakistani literature remains fragmented. Existing local studies are often small in scale, heterogeneous in methodology, or focused on isolated interventions without comprehensive assessment of functional mobility and muscle strength outcomes. Furthermore, disparities in rehabilitation practices, availability of orthotic services, and access to specialized care between urban and rural regions limit the direct applicability of international evidence to the Pakistani population. This lack of consolidated, context-specific evidence poses challenges for clinicians, educators, and policymakers striving to implement evidence-based rehabilitation approaches tailored to local needs (9,10). Given these gaps, there is a clear need to synthesize existing Pakistani evidence on physiotherapy and orthotic interventions for lower limb disorders. A focused review of the literature can provide a coherent overview of current practices, reported outcomes, and prevailing limitations, while also identifying areas requiring further research and clinical development. Therefore, the objective of this review is to critically analyze and summarize available Pakistani evidence on physiotherapy and orthotic management for lower limb disorders, with particular emphasis on their impact on functional mobility and muscle strength, in order to inform clinical practice and guide future rehabilitation strategies within the Pakistani healthcare context (5).

METHODS

This review adopted an evidence-based qualitative approach using a narrative review design guided by systematic principles to identify, appraise, and synthesize published literature on physiotherapy and orthotic interventions for lower limb disorders within the Pakistani healthcare context. This methodological approach was selected to allow inclusion of diverse study designs while maintaining methodological rigor, given the limited availability of large-scale randomized controlled trials in local rehabilitation research. The review focused on capturing clinically relevant evidence reflective of real-world rehabilitation practices across different healthcare settings in Pakistan. A comprehensive literature search was conducted across multiple electronic databases, including PubMed, Google Scholar, PakMediNet, and ScienceDirect, covering studies published from January 2005 to March 2025. The search strategy employed Boolean operators and combined key terms related to rehabilitation and context, including ("physiotherapy" OR "physical therapy") AND ("orthotic*" OR "ankle foot orthosis" OR "lower limb orthoses") AND ("functional mobility" OR "muscle strength" OR "gait") AND

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("Pakistan"). To minimize the risk of missing relevant studies, manual screening of reference lists from eligible articles was also performed. Only full-text articles published in English were considered to ensure accurate appraisal and interpretation of findings. Eligibility criteria were defined a priori. Studies were included if they were conducted in Pakistan and involved human participants of any age or gender diagnosed with neurological, musculoskeletal, or metabolic conditions affecting the lower limbs. Eligible study designs comprised randomized controlled trials, quasi-experimental studies, cohort studies, controlled clinical interventions, and observational studies that evaluated physiotherapy and/or orthotic interventions. Studies were required to report outcomes related to functional mobility, muscle strength, gait performance, balance, or functional independence. Exclusion criteria included studies conducted outside Pakistan, animal or laboratory-based research, studies focusing exclusively on upper limb rehabilitation, surgical or pharmacological interventions without a rehabilitation component, opinion pieces, editorials, conference abstracts without accessible full texts, unpublished data, and case reports lacking adequate methodological detail or functional outcome measures. The study selection process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. All identified records were imported into EndNote software for reference management and removal of duplicates. Titles and abstracts were initially screened, followed by full-text review of potentially eligible articles. Screening and eligibility assessment were carried out independently by two reviewers, and discrepancies were resolved through discussion to ensure transparency and minimize selection bias. A PRISMA flow diagram was used to document the identification, screening, eligibility, and final inclusion of studies. Quality appraisal of included studies was performed using the Critical Appraisal Skills Programme (CASP) checklists appropriate to each study design, enabling systematic evaluation of methodological quality, internal validity, and relevance to clinical practice. Data extraction and quality assessment were organized using Microsoft Excel to allow structured comparison across studies, including population characteristics, intervention details, outcome measures, and key findings. Narrative synthesis was undertaken using Microsoft Word, focusing on patterns of evidence, consistency of outcomes, and contextual factors influencing rehabilitation effectiveness, while EndNote was used to ensure consistency and accuracy of citations throughout the review.

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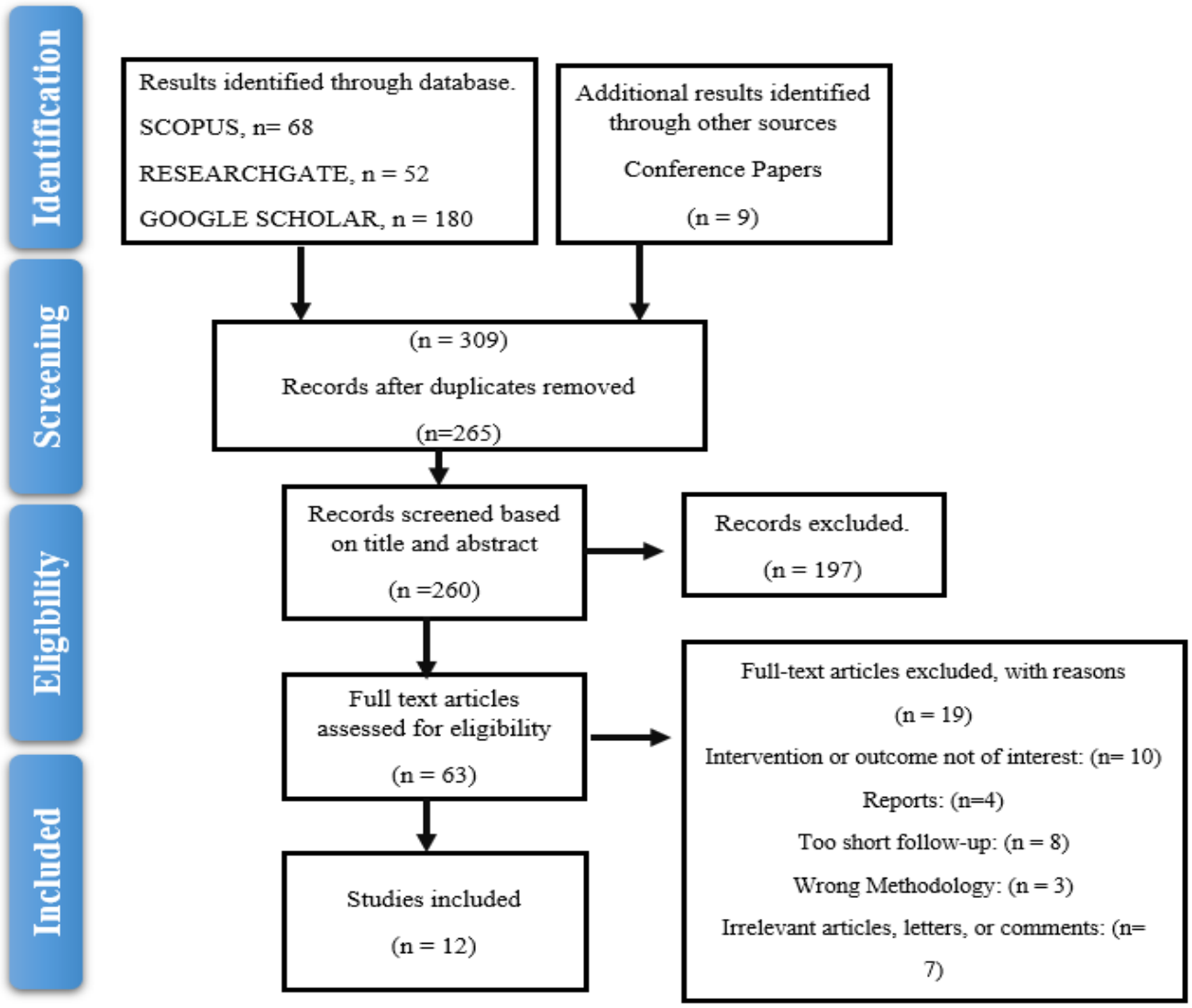

The PRISMA Framework

Figure 1 PRISMA Framework

RESULTS

The systematic search identified a broad pool of records related to physiotherapy and orthotic rehabilitation for lower limb disorders within the Pakistani healthcare context. Following database searching and manual reference screening, all retrieved records were subjected to duplicate removal and initial screening. Titles and abstracts were reviewed for relevance, after which full-text articles were assessed against predefined eligibility criteria. Studies were excluded if they were conducted outside Pakistan, did not involve lower limb rehabilitation, failed to report outcomes related to functional mobility or muscle strength, or lacked sufficient methodological detail. After completion of the PRISMA-guided identification, screening, and eligibility phases, a total of 12 studies fulfilled the inclusion criteria and were retained for final qualitative synthesis. The PRISMA flowchart illustrates the progression of study selection from identification to final inclusion. The characteristics of the included studies are summarized in Table 1. Collectively, the studies were

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published between 2020 and 2023 and represented a range of study designs, including randomized controlled trials, prospective and experimental interventional studies, quasi-experimental designs, and controlled clinical studies. Sample sizes ranged from small pediatric cohorts (n = 15–40) to larger adult rehabilitation samples (n = 120). The study populations encompassed a wide spectrum of neurological, musculoskeletal, orthopedic, and pediatric conditions, including knee osteoarthritis, stroke, cerebral palsy, pelvic girdle pain, lower limb amputation, toe walking due to Achilles tendon tightness, and post-orthopedic surgery recovery. Both male and female participants were represented, with ages spanning from early childhood to older adulthood, reflecting the diverse clinical burden of lower limb disorders in Pakistan. Interventions varied across studies and included progressive resistance training, joint mobilization, functional strength training, neuromuscular electrical stimulation, supported standing, ankle–foot orthoses, footwear modifications, lateral wedge insoles, phantom exercises, and group-based physiotherapy programs. Outcomes were primarily measured using validated functional and clinical tools such as WOMAC, KOOS, Katz Index of Activities of Daily Living, Timed Up and Go test, Gross Motor Function Measure, Modified Ashworth Scale, Functional Independence Measure, Lower Extremity Functional Scale, and pain and quality-of-life indices.

Quality appraisal using Critical Appraisal Skills Programme checklists revealed overall moderate methodological quality across the included studies. Randomized controlled trials demonstrated appropriate randomization and outcome reporting, although blinding was inconsistently applied, increasing the risk of performance bias. Several interventional and quasi-experimental studies lacked control groups, which limited causal inference and increased susceptibility to selection bias and maturation effects. Small sample sizes and short intervention durations were common limitations, particularly in pediatric and neurological studies. Additionally, variability in intervention protocols and outcome measures introduced heterogeneity, restricting direct comparison across studies. Despite these limitations, most studies employed standardized assessment tools and reported clinically meaningful outcomes, supporting their relevance to rehabilitation practice. Across physiotherapy-focused interventions, consistent improvements were observed in functional mobility, muscle strength, pain reduction, and balance performance. Progressive resistance training and task-oriented strengthening demonstrated statistically significant improvements in mobility-related outcomes such as WOMAC pain scores, Katz ADL indices, Timed Up and Go performance, and Gross Motor Function Measure domains, with reported p-values ranging from <0.05 to 0.003 in controlled comparisons. Interventions incorporating proximal control strategies, such as hip mobilization and strengthening, yielded superior improvements in pain, function, and dynamic balance compared with conventional approaches alone. Neuromuscular strategies, including supported standing combined with functional electrical stimulation in acute stroke, resulted in significant within- and between-group gains in lower limb strength and functional mobility, reinforcing the benefits of early, activity-based rehabilitation. Orthotic-based interventions demonstrated meaningful functional benefits, particularly in gait-related outcomes. Ankle–foot orthoses combined with stretching exercises significantly reduced toe-walking frequency by approximately 45% and improved ankle range of motion within one month. Footwear modification strategies in medial knee osteoarthritis produced statistically significant improvements in KOOS pain and activities of daily living domains, although gains in quality-of-life measures appeared to plateau over longer follow-up periods, suggesting the need for concurrent rehabilitative input.

Studies examining combined or integrated rehabilitation approaches indicated that multimodal strategies often yielded broader functional gains. Comparisons between orthotic support and conventional physiotherapy showed improvements in both groups; however, structured physiotherapy consistently produced greater improvements in functional independence and mobility-related domains. Cognitive-motor interventions such as phantom exercises significantly reduced pain severity and improved quality-of-life parameters, although gains in ambulatory potential were similar between intervention and control groups. Service-level integration, exemplified by group-based physiotherapy following orthopedic surgery, resulted in statistically and clinically significant improvements in functional independence, lower extremity function, and social reintegration compared with standard individual therapy, highlighting the added value of combining physical rehabilitation with psychosocial and community-oriented components. Overall, the synthesized evidence indicates that physiotherapy, orthotic, and combined rehabilitation interventions are effective in improving functional mobility and muscle strength among individuals with lower limb disorders in Pakistan, despite methodological heterogeneity and moderate risk of bias across studies.

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Table 1: Summary of Included Studies on Physiotherapy, Orthotic, and Combined Interventions for Lower Limb Disorders

Author(s)	Study Title	Aim of the Study	Study Design	Key Outcomes
Rafiq et al. (2023)	Effects of Progressive Resistance Strength Training on Knee Osteoarthritis	To evaluate the effects of progressive resistance training on pain, mobility, and activities of daily living in knee osteoarthritis	Prospective interventional study	Significant improvements observed in WOMAC pain scores, Katz ADL scores, and Timed Up and Go performance following intervention
Mehwish et al. (2021)	Hip Joint Mobilisations and Strength Training in Knee Osteoarthritis	To assess the impact of hip joint mobilisations combined with strengthening exercises on pain, function, and balance	Prospective interventional study	Marked improvements noted in pain, physical function, and dynamic balance following intervention
Rehan et al.	Mulligan Mobilization versus Strengthening Exercises in Pelvic Girdle Pain	To examine the effects of mobilization, strengthening, and combined physiotherapy approaches in pelvic girdle pain	Interventional clinical study	Combined physiotherapy approach demonstrated the greatest reductions in pain and disability with improved quality of life
Iftikhar et al. (2021)	Supported Standing with Functional Electrical Stimulation in Acute Stroke	To determine the effects of supported standing combined with functional electrical stimulation on strength and mobility	Interventional clinical study	Substantial improvements reported in balance, functional mobility, and lower limb strength
Afzal et al.	Functional Strength Training in Hemiplegic Cerebral Palsy	To explore the effects of additional functional strength training on mobility in children with hemiplegic cerebral palsy	Experimental interventional study	Significant gains observed in gross motor function and functional strength outcomes
Mannan et al. (2020)	Universal Exercise Unit Training in Cerebral Palsy	To examine the effects of functional strength training on lower limb spasticity	Quasi-experimental interventional study	Spasticity levels reduced from 3.4 ± 0.5 to 1.46 ± 0.99 following intervention
Anees et al.	Physiotherapy Interventions in Children with Erb's Palsy	To evaluate the effects of physiotherapy on strength, range of motion, and functional performance	Clinical interventional study	Notable improvements observed in muscle strength, joint range, and functional abilities
Miran et al.	Ankle–Foot Orthoses with Stretching in Toe-Walking Children	To evaluate the effectiveness of ankle–foot orthoses combined with stretching exercises	Experimental interventional study	Toe-walking frequency reduced by approximately 45%, with improved ankle range of motion
Janjua et al.	Footwear Modification in Medial Knee Osteoarthritis	To assess the impact of footwear modification strategies on activities of daily living	Prospective interventional study	Improvements noted in KOOS pain and ADL domains following combined footwear intervention
Riaz et al.	Lateral Wedge Insoles and Physiotherapy in Knee Osteoarthritis	To examine the effects of lateral wedge insoles and physiotherapy on functional outcomes	Interventional clinical study	Both approaches improved outcomes, with greater functional independence following physiotherapy

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Author(s)	Study Title	Aim of the Study	Study Design	Key Outcomes
Zaheer et al. (2021)	Phantom Exercises in Lower Limb Amputees	To assess the effects of phantom exercises on pain, mobility, and quality of life	Interventional clinical study	Greater pain reduction reported following phantom exercise intervention; mobility improved overall
Masood et al.	Group-Based Physiotherapy Following Orthopedic Surgery	To evaluate the influence of group-based rehabilitation on functional recovery and social reintegration	Prospective interventional study	Higher functional independence, lower extremity function, and social reintegration scores observed

DISCUSSION

This review synthesized evidence from twelve Pakistani studies examining physiotherapy, orthotic, and combined rehabilitation interventions for improving functional mobility and muscle strength in individuals with lower limb disorders. Overall, the findings indicated that rehabilitation-based interventions produced meaningful improvements in pain, mobility, and strength-related outcomes, with physiotherapy-focused and integrated approaches demonstrating more consistent and clinically relevant benefits than orthotic-only strategies. These results supported the growing recognition that active, task-oriented rehabilitation is central to restoring lower limb function, particularly in settings where delayed presentation and limited resources exacerbate disability. Physiotherapy-oriented interventions showed the most consistent improvements across functional and strength-related outcomes (11,12). Interventions incorporating progressive resistance training, strengthening, mobilization, and task-specific exercises were associated with statistically significant reductions in pain and gains in activities of daily living and functional mobility. Improvements in standardized outcomes such as WOMAC, Katz Index, and Timed Up and Go reflected not only symptomatic relief but also meaningful functional recovery. These findings aligned closely with international evidence demonstrating moderate effect sizes of exercise-based rehabilitation on pain and physical function in knee osteoarthritis and other lower limb conditions, reinforcing the biological plausibility and external validity of these results within the Pakistani context (13,14). The convergence of local and global evidence suggested that, despite healthcare system constraints, appropriately designed physiotherapy programs could yield outcomes comparable to those reported in high-income settings. Interventions that emphasized proximal control and kinetic chain optimization appeared particularly effective. Studies integrating hip mobilization and strengthening with conventional knee-focused exercises demonstrated superior improvements in pain, physical function, and dynamic balance compared with isolated strengthening approaches. This supported established biomechanical concepts that proximal muscle control influences distal joint loading and gait efficiency, thereby enhancing overall functional mobility. Such findings were consistent with international literature indicating that proximal strengthening could reduce aberrant lower limb mechanics and improve knee-related functional outcomes (15,16). Within the Pakistani rehabilitation environment, these results underscored the importance of comprehensive, whole-limb assessment and intervention rather than isolated joint-focused treatment.

Orthotic-only interventions showed more variable outcomes. While studies evaluating ankle–foot orthoses and footwear modifications reported short-term improvements in gait parameters, ankle range of motion, and pain-related outcomes, these benefits were less consistent across broader functional domains. Reductions in toe-walking frequency and improvements in gait alignment highlighted the capacity of orthoses to correct biomechanical deviations and provide external support. However, the plateauing of quality-of-life gains and limited effects on long-term functional independence suggested that orthotic devices alone might be insufficient to sustain meaningful recovery. This pattern was in line with international findings showing that orthoses could normalize gait mechanics in the short term but required concurrent active rehabilitation to translate biomechanical correction into durable functional gains (17-19). These observations reinforced the view that orthoses should be considered facilitators of movement rather than stand-alone treatments. The strongest and most comprehensive outcomes were observed in studies employing combined or integrated rehabilitation approaches. Interventions that combined physiotherapy with orthotic support, cognitive-motor strategies, or structured service-delivery models demonstrated broader improvements in pain control, functional independence, and social reintegration. While orthotic interventions effectively reduced pain and improved joint-specific outcomes, structured physiotherapy consistently produced greater gains in functional independence and mobility-related measures. This pattern mirrored international evidence suggesting that multimodal

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rehabilitation strategies, particularly those that enhance adherence and integrate physical and psychosocial components, yield superior functional outcomes compared with single-modality interventions (20,21). These findings were particularly relevant in the Pakistani setting, where social support, accessibility, and continuity of care strongly influence rehabilitation success.

Several strengths of this review should be acknowledged. It provided a focused synthesis of context-specific evidence, addressing a critical gap in Pakistani rehabilitation literature. The inclusion of diverse populations, age groups, and clinical conditions enhanced the ecological validity of the findings and reflected real-world rehabilitation practice. The use of validated outcome measures across studies further strengthened the interpretability of results. However, important limitations were also evident. Many included studies had small sample sizes, short intervention durations, and limited follow-up, restricting the ability to assess long-term sustainability of outcomes. Methodological heterogeneity, inconsistent blinding, and the absence of control groups in several studies increased the risk of bias and limited causal inference. Additionally, variability in intervention protocols and outcome reporting hindered direct comparison across studies and precluded quantitative synthesis. Future research should prioritize well-designed, adequately powered randomized controlled trials with standardized outcome measures and longer follow-up periods to evaluate the durability of functional gains. Greater attention to combined rehabilitation models that integrate physiotherapy, orthotic management, and psychosocial support is warranted, particularly in low-resource settings (22,23). Addressing barriers such as delayed referral, limited access to orthotic services, and disparities between urban and rural healthcare facilities may further enhance rehabilitation outcomes. Collectively, the findings of this review suggested that while physiotherapy and orthotic interventions were individually beneficial, integrated rehabilitation strategies offered the most promising pathway for improving functional mobility and muscle strength among individuals with lower limb disorders in Pakistan.

CONCLUSION

This review highlighted that rehabilitation strategies play a pivotal role in improving functional mobility and muscle strength among individuals with lower limb disorders within the Pakistani healthcare context. Physiotherapy interventions consistently emerged as the most effective approach, demonstrating broad benefits across pain reduction, mobility, balance, and functional independence in diverse patient populations. Orthotic interventions showed mixed effectiveness, with outcomes largely influenced by appropriate prescription, patient comfort, and their integration into active rehabilitation programs, underscoring that orthoses alone may provide limited functional gains. The most meaningful and sustainable improvements were observed when physiotherapy was combined with orthotic support or other integrated rehabilitation strategies. Collectively, these findings emphasize the importance of comprehensive, multimodal rehabilitation approaches tailored to local clinical realities, reinforcing their value for guiding evidence-based practice and optimizing patient-centered functional recovery.

Author Contributions

Author	Contribution
Esha Irfan*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Tehreem Mukhtar	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Omme Habiba	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Irum Hassan	Contributed to Data Collection and Analysis

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	Has given Final Approval of the version to be published
Tooba Nadeem	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Sumble Arif	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Adil Shakil	Contributed to study concept and Data collection Has given Final Approval of the version to be published

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