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Original Article

Utilization and Perceived Effectiveness of Telerehabilitation Services in Musculoskeletal Disorders: A Cross-Sectional Study Among Physiotherapists

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ABSTRACT

Background: Telerehabilitation is increasingly used in musculoskeletal (MSK) physiotherapy, yet clinician-level evidence on utilization, perceived effectiveness, and implementation barriers in low- and middle-income urban settings remains limited. Objective: To assess telerehabilitation utilization patterns, perceived clinical effectiveness, and predictors of high perceived effectiveness among physiotherapists managing MSK disorders in Lahore. Methods: A cross-sectional survey of 510 physiotherapists was conducted using a structured questionnaire capturing demographics, telerehabilitation utilization, perceived effectiveness across clinical domains (Likert 1–5), implementation barriers, and contextual practice characteristics. Multivariable logistic regression identified predictors of high perceived effectiveness, reporting adjusted odds ratios (AORs) with 95% confidence intervals (CIs). Results: Overall, 68.2% reported ever using telerehabilitation and 54.9% used it in the past three months; weekly/daily use was 37.6%, and the median MSK share managed remotely was 22% (IQR 10–35). Perceived effectiveness was highest for patient education (4.18 ± 0.71; 83.5% agreement) and exercise adherence (4.02 ± 0.76; 78.6%), while shoulder assessment confidence was lowest (2.91 ± 0.88; 34.5%). The leading barriers were limited hands-on assessment (4.12 ± 0.73; 70.2% major barrier) and internet instability (3.89 ± 0.84; 61.0%). High perceived effectiveness was independently associated with prior training (AOR 2.41, 95% CI 1.68–3.46), weekly/daily use (AOR 2.98, 95% CI 2.01–4.41), and good internet quality (AOR 1.72, 95% CI 1.15–2.58). Conclusion: Telerehabilitation is widely utilized for MSK care in Lahore and is perceived as particularly effective for education and adherence support; however, assessment limitations and connectivity barriers remain central. Training and infrastructure strengthening may improve clinician-perceived effectiveness and implementation. Keywords: telerehabilitation; telehealth; musculoskeletal disorders; physiotherapy; perceived effectiveness; barriers; Pakistan.

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INTRODUCTION

Musculoskeletal disorders (MSDs) represent a leading cause of disability worldwide, accounting for substantial functional limitation, reduced productivity, and healthcare utilization across both developed and developing settings (1). Conditions such as low back pain, knee osteoarthritis, and shoulder disorders contribute significantly to years lived with disability and impose sustained economic burden on health systems (2). Physiotherapy remains a cornerstone in the management of MSDs, emphasizing pain modulation, functional restoration, exercise therapy, and patient education (3). However, traditional in-person physiotherapy services are often constrained by geographic barriers, time limitations, workforce distribution inequities, and resource availability, particularly in rapidly urbanizing regions (4).

Telerehabilitation has emerged as a technology-enabled model of care delivery, facilitating remote assessment, monitoring, and therapeutic guidance through video conferencing, digital platforms, and telecommunication tools (5). Evidence suggests that telerehabilitation can achieve comparable outcomes to face-to-face physiotherapy for selected MSK conditions, particularly in terms of pain reduction, functional improvement, and adherence to prescribed exercises (6,7). Moreover, digital health

interventions have demonstrated enhanced accessibility, cost-effectiveness, and patient satisfaction in various rehabilitation contexts (8). Despite these advantages, concerns persist regarding the adequacy of remote physical assessment, therapeutic alliance, digital literacy barriers, data security, and reimbursement policies (9,10).

Within the context of musculoskeletal physiotherapy, telerehabilitation is particularly relevant for chronic low back pain, knee disorders, and shoulder dysfunctions, where structured exercise therapy and behavioral education form the backbone of management (11). Nevertheless, confidence in conducting remote joint assessments—especially for complex shoulder pathology—remains variable among clinicians (12). Furthermore, uptake of telerehabilitation appears to depend not only on technological infrastructure but also on clinician training, prior exposure, and frequency of use (13). Studies indicate that structured training and institutional support significantly enhance clinician-perceived effectiveness and sustained implementation (14).

In Pakistan and comparable South Asian healthcare systems, digital health adoption is expanding; however, empirical data examining physiotherapists' utilization patterns and perceived clinical effectiveness of telerehabilitation in MSDs remain limited. Existing literature predominantly focuses on patient outcomes or high-income country settings, leaving a contextual knowledge gap regarding clinician-level determinants in urban centers such as Lahore (15). Understanding physiotherapists' adoption behavior, perceived effectiveness domains, and implementation barriers is essential to inform workforce training strategies and health policy planning.

The Population of interest in this study comprises licensed physiotherapists managing musculoskeletal conditions in Lahore; the Intervention/exposure is the use of telerehabilitation services for MSK disorders; the Comparison involves differences across training status, usage frequency, and contextual practice characteristics; and the Outcomes include utilization patterns, perceived clinical effectiveness, and predictors of high perceived effectiveness. Therefore, this study aims to assess the utilization and perceived effectiveness of telerehabilitation services in musculoskeletal disorders among physiotherapists in Lahore and to identify independent predictors associated with high perceived effectiveness. It is hypothesized that prior telerehabilitation training and frequent use will be significantly associated with higher perceived effectiveness scores.

MATERIALS AND METHODS

This cross-sectional observational study was conducted among licensed physiotherapists practicing in Lahore, Pakistan. The study was designed to evaluate patterns of telerehabilitation utilization and perceived clinical effectiveness in the management of musculoskeletal disorders. Data collection was carried out over a defined three-month period using a structured, self-administered questionnaire distributed through professional physiotherapy networks, institutional contacts, and digital platforms. The study adhered to internationally accepted reporting standards for observational research (16).

Eligible participants were registered physiotherapists currently practicing in Lahore who were actively involved in the management of musculoskeletal conditions. Physiotherapists exclusively practicing in non-MSK specialties or not engaged in active clinical care were excluded. Participants were recruited through purposive and snowball sampling strategies using professional associations, hospital departments, private clinics, and online professional groups. Participation was voluntary, and informed consent was obtained electronically prior to questionnaire completion.

The survey instrument was developed based on existing literature on telerehabilitation implementation and clinician-perceived effectiveness (17,18). Content validity was ensured through expert review by senior physiotherapists and a biostatistician. A pilot test was conducted on a subset of physiotherapists to assess clarity, internal consistency, and feasibility; necessary refinements were made prior to final distribution. The final questionnaire comprised five domains: demographic and professional

characteristics; telerehabilitation utilization patterns; perceived clinical effectiveness; perceived barriers; and contextual practice characteristics.

Demographic variables included age, gender, highest academic qualification, years of clinical experience, practice setting (private/public), geographic setting (urban), prior formal telerehabilitation training, and percentage of MSK caseload. Utilization variables included history of telerehabilitation use, frequency of use (weekly/daily versus less frequent), types of services provided (video consultation, audio-only, exercise supervision, follow-up consultation), and common MSK conditions managed remotely.

Perceived clinical effectiveness was measured using a multi-item Likert-scale instrument (1 = strongly disagree to 5 = strongly agree) assessing domains such as pain reduction effectiveness, functional improvement, exercise adherence, patient education, therapeutic alliance, joint assessment confidence, and safety in MSK cases. A composite total effectiveness score was calculated by summing individual domain scores. High perceived effectiveness was operationally defined using a pre-specified cut-off based on distributional criteria (upper tertile of total score). Barriers to telerehabilitation implementation were assessed using Likert-scale ratings of severity across domains including limited hands-on assessment, internet instability, patient digital literacy, privacy/legal concerns, and reimbursement limitations.

To minimize bias, anonymous data collection was employed to reduce social desirability bias. Clear operational definitions were provided within the questionnaire to ensure uniform interpretation. Multivariable analysis was conducted to control for potential confounders such as years of experience, practice setting, and internet quality. Missing data were assessed for randomness; cases with substantial incomplete responses were excluded from inferential analysis, while minimal missing values were handled using complete-case analysis.

The sample size was determined to ensure adequate statistical power for multivariable logistic regression analysis, assuming at least 10 outcome events per predictor variable (19). With 208 participants classified under high perceived effectiveness, the sample of 510 physiotherapists provided sufficient power to estimate adjusted odds ratios with stable confidence intervals.

Statistical analysis was performed using SPSS (version 26.0). Descriptive statistics were reported as mean ± standard deviation for continuous variables and frequencies with percentages for categorical variables. Median and interquartile range were used for skewed variables. Group comparisons were conducted using chi-square tests for categorical variables and independent t-tests for continuous variables. Multivariable logistic regression analysis was performed to identify independent predictors of high perceived effectiveness, reporting adjusted odds ratios (AORs), 95% confidence intervals (CIs), and p-values. Model fitness was evaluated using the likelihood ratio chi-square test, Nagelkerke R^2, and overall classification accuracy. Statistical significance was set at $p < 0.05$.

Ethical approval was obtained from a recognized institutional review committee prior to commencement of the study. All procedures were conducted in accordance with the principles of the Declaration of Helsinki (20). Data were stored securely with restricted access, and no identifiable information was collected. To enhance reproducibility, the full survey instrument, coding framework, and statistical analysis plan were predefined prior to data analysis. Variable coding procedures, inclusion criteria, and regression modeling strategy were documented to permit independent replication.

RESULTS

A total of 510 physiotherapists from Lahore participated, with a mean age of 31.8 ± 6.4 years. Most respondents were male (58.4%), practiced in urban settings (72.5%), and worked in private practice (61.6%). Nearly half reported >5 years' experience (44.9%), and 46.9% had prior telerehabilitation training. The mean musculoskeletal caseload was 64.5% ± 18.2.

Table 1. Participant Characteristics (N = 510)

Variable	Value
Age (years), mean ± SD	31.8 ± 6.4
Male, n (%)	298 (58.4)
Female, n (%)	212 (41.6)
MSc/MPhil or higher, n (%)	274 (53.7)
Experience >5 years, n (%)	229 (44.9)
Private practice, n (%)	314 (61.6)
Urban practice, n (%)	370 (72.5)
Prior telerehab training, n (%)	239 (46.9)
MSK caseload (%), mean ± SD	64.5 ± 18.2

Table 2. Telerehabilitation Utilization Patterns (N = 510)

Variable	n (%)
Ever used telerehabilitation	348 (68.2)
Used in last 3 months	280 (54.9)
Weekly/Daily use	192 (37.6)
Median % MSK patients via telerehab	22% (IQR 10–35)
Modalities used (among users, n = 348)	
Video consultations	287 (82.5)
Audio-only	154 (44.3)
Exercise supervision	240 (69.1)
Follow-up consultations	259 (74.3)
Common MSK conditions managed (among users, n = 348)	
Low back pain cases	222 (63.7)
Knee disorders	180 (51.8)
Shoulder disorders	121 (34.8)

Overall, 68.2% (348/510) reported ever using telerehabilitation, and 54.9% (280/510) had used it in the prior 3 months. Weekly/daily use was reported by 37.6% (192/510). Among those who used telerehabilitation, video consultations predominated (82.5%), followed by follow-up consultations (74.3%) and exercise supervision (69.1%). The median proportion of MSK patients managed via telerehabilitation was 22% (IQR 10–35). Low back pain was the most commonly managed condition remotely (63.7%), followed by knee disorders (51.8%) and shoulder disorders (34.8%).

Table 3. Perceived Clinical Effectiveness (Likert 1–5)

Domain	Mean ± SD	Agree/Strongly Agree, n (%)
Pain reduction effectiveness	3.62 ± 0.84	336 (65.9)
Functional improvement	3.74 ± 0.79	351 (68.8)
Exercise adherence	4.02 ± 0.76	401 (78.6)
Patient education	4.18 ± 0.71	426 (83.5)
Therapeutic alliance	3.55 ± 0.88	298 (58.4)
Knee assessment confidence	3.21 ± 0.82	251 (49.2)
Shoulder assessment confidence	2.91 ± 0.88	176 (34.5)
Safety in MSK cases	3.89 ± 0.77	372 (72.9)
Total effectiveness score	36.9 ± 5.8	—
High effectiveness category	208 (40.8%)	—

Perceived effectiveness was strongest for patient education (mean 4.18 ± 0.71; 83.5% agreement) and exercise adherence (4.02 ± 0.76; 78.6% agreement). Perceived safety in MSK cases was also high (3.89 ± 0.77; 72.9% agreement). In contrast, confidence in remote joint assessment was lower, particularly for shoulder assessment (2.91 ± 0.88; 34.5% agreement) compared with knee assessment (3.21 ± 0.82; 49.2% agreement). The mean total effectiveness score was 36.9 ± 5.8, and 40.8% of participants met the high perceived effectiveness threshold.

Table 4. Major Barriers (Ranked by Mean Severity)

Barrier	Mean ± SD	Major Barrier, n (%)
Limited hands-on assessment	4.12 ± 0.73	358 (70.2)
Internet instability	3.89 ± 0.84	311 (61.0)
Low patient digital literacy	3.74 ± 0.88	287 (56.3)
Privacy/legal concerns	3.12 ± 0.94	198 (38.8)
Lack of reimbursement	3.05 ± 1.02	182 (35.7)

The dominant implementation challenge was limited hands-on assessment (mean 4.12 ± 0.73), endorsed as a major barrier by 70.2%. Technology and access constraints were also prominent, including internet instability (3.89 ± 0.84; 61.0%) and low patient digital literacy (3.74 ± 0.88; 56.3%). Policy-related barriers were comparatively less severe, though still notable, including privacy/legal concerns (3.12 ± 0.94; 38.8%) and lack of reimbursement (3.05 ± 1.02; 35.7%).

Table 5. Predictors of High Perceived Effectiveness (Multivariable Logistic Regression)

Variable	AOR	95% CI	p-value
Prior training	2.41	1.68–3.46	<0.001
Weekly/Daily use	2.98	2.01–4.41	<0.001
Experience >5 years	1.29	0.89–1.86	0.171
Urban setting	1.22	0.83–1.79	0.312
Good internet quality	1.72	1.15–2.58	0.008

Model $\chi^2 = 64.3$, $p < 0.001$; Nagelkerke $R^2 = 0.29$; Classification accuracy = 73.4%

In adjusted analysis, prior telerehabilitation training was associated with more than two-fold higher odds of high perceived effectiveness (AOR 2.41, 95% CI 1.68–3.46; $p < 0.001$). Weekly/daily use showed the strongest association (AOR 2.98, 95% CI 2.01–4.41; $p < 0.001$). Good internet quality was also independently associated with high perceived effectiveness (AOR 1.72, 95% CI 1.15–2.58; $p = 0.008$). In contrast, experience >5 years and urban setting were not statistically significant predictors after adjustment. The model demonstrated acceptable explanatory power (Nagelkerke $R^2 = 0.29$) and a classification accuracy of 73.4%.

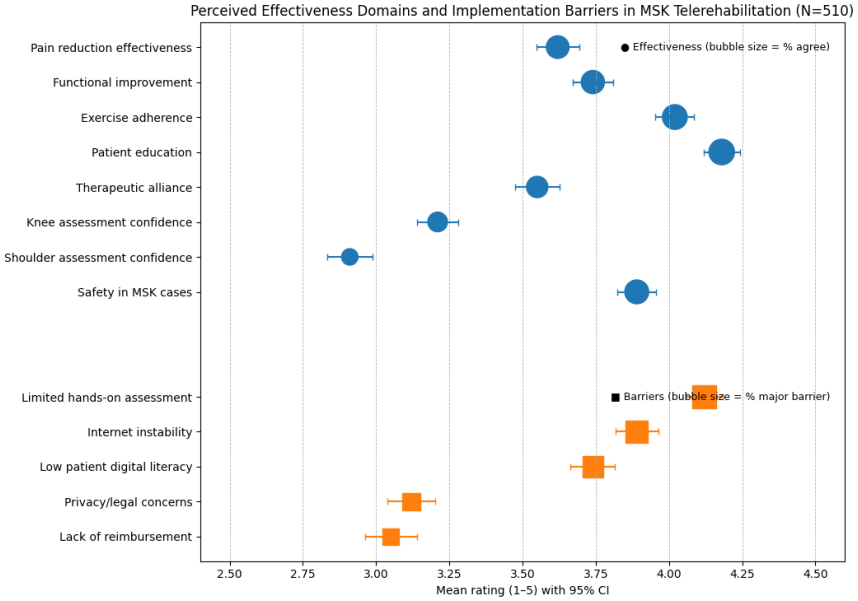

Figure 1. Perceived Effectiveness Domains and Implementation Barriers in MSK Telerehabilitation (N=510).

The figure demonstrates a clear gradient in perceived effectiveness, with the highest mean ratings for patient education (4.18) and exercise adherence (4.02), each supported by high agreement proportions (83.5% and 78.6%, respectively), while assessment confidence shows the lowest means—particularly for shoulder assessment (2.91) with only 34.5% agreement—indicating a clinically meaningful "assessment confidence gap" despite favorable perceptions of education- and exercise-centered care; concurrently, barrier severity clusters at the upper end for limited hands-on assessment (4.12; 70.2% major barrier) and technology-related constraints such as internet instability (3.89; 61.0%), reinforcing that the strongest implementation friction points align with domains where direct physical examination and real-time interaction are most critical.

DISCUSSION

This study provides clinician-level evidence from Lahore indicating that telerehabilitation is now commonly integrated into musculoskeletal (MSK) physiotherapy practice, with 68.2% reporting lifetime use and 54.9% use within the last three months, while the typical MSK share managed remotely remained modest (median 22%, IQR 10–35). These patterns align with broader shifts toward digitally enabled rehabilitation workflows and hybrid care models, particularly after rapid telehealth expansion globally. The predominance of video consultations (82.5%) and the high use of follow-up and exercise supervision functions (74.3% and 69.1%) are clinically coherent with MSK care where education, pacing,

self-management, and progressive exercise dosage can be delivered effectively without continuous manual contact, especially for stable or follow-up phases of care (21,22).

Perceived effectiveness showed a consistent gradient favoring education- and adherence-related domains, with patient education rated highest (4.18 ± 0.71; 83.5% agreement) and exercise adherence also high (4.02 ± 0.76; 78.6% agreement). This profile is concordant with evidence that real-time telerehabilitation and app-supported programs can improve self-management behaviors and engagement when structured exercise prescription and coaching are prioritized (23). By contrast, the lowest ratings were observed for shoulder assessment confidence (2.91 ± 0.88; 34.5% agreement) and knee assessment confidence (3.21 ± 0.82; 49.2% agreement), highlighting an "assessment confidence gap" that likely reflects the intrinsic difficulty of translating palpation-dependent tests, end-feel assessment, and nuanced special testing into a remote format. Prior MSK telerehabilitation literature similarly notes that while outcomes for pain and function may be comparable for selected conditions, implementation concerns persist around physical examination validity and decision-making for complex presentations (21,24). Notably, therapeutic alliance was moderate (3.55 ± 0.88; 58.4% agreement), suggesting that relationship-building is achievable but may require explicit communication training, patient preparation, and continuity strategies to avoid a transactional remote experience (25).

Barriers were dominated by limited hands-on assessment (4.12 ± 0.73; 70.2% major barrier), followed by internet instability (3.89 ± 0.84; 61.0%) and low patient digital literacy (3.74 ± 0.88; 56.3%). This barrier structure supports a pragmatic interpretation: perceived clinical constraints are less about whether telerehabilitation can deliver education and exercise coaching, and more about (i) managing diagnostic uncertainty and red flags without direct examination and (ii) ensuring stable, high-quality connectivity for safe and efficient real-time interaction. These findings are consistent with international telehealth implementation evidence emphasizing infrastructure reliability, usability, and clinician training as core determinants of confidence and sustained adoption (26).

The multivariable model strengthens this interpretation by showing that prior telerehabilitation training (AOR 2.41, 95% CI 1.68–3.46) and frequent use (weekly/daily) (AOR 2.98, 95% CI 2.01–4.41) were the most influential predictors of high perceived effectiveness, while years of experience alone was not statistically significant. This suggests that "experience with the modality" and purposeful skill acquisition may be more decisive than general clinical tenure. In addition, good internet quality independently predicted higher perceived effectiveness (AOR 1.72, 95% CI 1.15–2.58), reinforcing that perceived clinical value is partially contingent on the technical conditions needed for high-fidelity visual assessment, cueing, and patient safety monitoring. Given the explained variance (Nagelkerke $R^2 = 0.29$) and classification accuracy (73.4%), the model indicates meaningful—but not exhaustive—capture of determinants, implying that additional factors such as organizational workflows, documentation burden, medico-legal clarity, and patient case-mix may contribute and warrant exploration in subsequent studies.

Several limitations should be considered when interpreting these findings. The cross-sectional design precludes causal inference, and the reliance on self-reported practices and perceptions may introduce recall and desirability bias. The sampling approach, although efficient for clinician recruitment, may over-represent physiotherapists who are more digitally engaged, potentially inflating utilization estimates. The effectiveness construct reflects perceived effectiveness rather than patient-level outcomes; therefore, conclusions should be interpreted as clinician acceptability and confidence rather than definitive clinical equivalence. Nonetheless, the study provides actionable implementation signals for Lahore: targeted clinician training focused on remote MSK assessment pathways, structured triage/red-flag protocols, and communication strategies for alliance-building may address the lowest-rated effectiveness domains, while system-level improvements in connectivity and patient digital onboarding could directly reduce the top-ranked barriers.

CONCLUSION

Among physiotherapists in Lahore managing MSK disorders, telerehabilitation was widely utilized and perceived as clinically effective for patient education, exercise adherence support, and safety in many MSK cases; however, major implementation constraints persisted around limited hands-on assessment and variable connectivity, and confidence in remote joint assessment—particularly shoulder assessment—remained comparatively low. Prior telerehabilitation training, frequent use, and good internet quality were independently associated with high perceived effectiveness, supporting the prioritization of competency-based training and infrastructure strengthening to optimize MSK telerehabilitation delivery.

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