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Strategic Management of Lower Back Pain with Application of Different Dynamics

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ABSTRACT

Background: Low back pain (LBP) is the foremost contributor to years lived with disability worldwide, and its prevalence continues to rise, placing substantial demands on healthcare systems. Contemporary guidelines advocate a shift toward individualized, non-pharmacological, and biopsychosocially informed management; however, real-world translation of these recommendations remains inconsistent, especially in low- and middle-income countries where private physiotherapy clinics are often the primary point of musculoskeletal care. Objective: This study aimed to characterize the real-world application of diverse non-pharmacological treatment modalities and technology-enabled strategies for LBP by licensed physiotherapists in Pakistan and to evaluate the extent to which these practices align with current evidence-based guidelines. Methods: A cross-sectional survey was administered to 200 licensed physiotherapists with more than six months of private clinical practice. A validated, structured online questionnaire captured demographic data, clinical characteristics, and frequency of modality use. Data were analyzed descriptively and inferentially ($p<0.05$) to identify utilization trends and associations with clinician variables. Results: Of the respondents, 61.0% were female and 39.0% male. Passive thermotherapies were the most frequently employed interventions, with heating pads used by 50.0% of clinicians and cold packs by 42.5%. Stretching exercises were reported by 46.5%, followed by transcutaneous electrical nerve stimulation (37.5%), manipulation (37.0%), weight management interventions (36.0%), and yoga (34.5%). More advanced or specialist approaches were less commonly applied, including neurodynamic techniques (32.0%), dry needling (22.0%), and weight-bearing functional exercises (17.0%). Across all categories, only thermotherapy exceeded the 50% usage threshold, and active guideline-recommended strategies remained underutilized. Conclusion: Physiotherapy practice for LBP in Pakistan remains disproportionately oriented toward passive modalities, underscoring the need for targeted implementation strategies, clinical decision frameworks, and education initiatives to support a transition toward active, personalized, and evidence-informed rehabilitation models.

Keywords

Low back pain, physiotherapy, non-pharmacological management, clinical practice patterns, evidence-based care.

INTRODUCTION

Low back pain remains the single largest cause of years lived with disability worldwide, contributing significantly to global morbidity and socioeconomic burden (1). Despite decades of research and refinement of clinical guidelines, the condition continues to affect hundreds of millions of individuals, with its prevalence projected to rise substantially in coming decades, underscoring the need for scalable, evidence-informed interventions that can be integrated into everyday care settings (1). Current international recommendations emphasize a shift away from passive or purely pharmacological treatments toward individualized, non-pharmacological, and biopsychosocially informed approaches that address biological, psychological, and social contributors to pain (2). However, the translation of such evidence into routine clinical practice remains inconsistent, particularly in low- and middle-income countries where health system resources are constrained and first-line care is often delivered by physiotherapists in community or private clinical settings (2). In Pakistan, where private physiotherapy clinics frequently serve as the initial point of contact for musculoskeletal complaints, there is limited evidence describing how closely real-world clinical practice aligns with these contemporary recommendations (2).

A growing body of research supports the clinical value of established physiotherapeutic techniques as well as emerging technology-enabled strategies in the strategic management of low back pain. Manual and myofascial interventions are associated with significant reductions in pain intensity and improvements in spinal mobility when incorporated into multimodal treatment plans (3). Artificial intelligence–based decision support systems are increasingly demonstrating strong predictive performance in clinical decision-making for degenerative lumbar spine conditions, with potential to standardize triage processes and minimize unwarranted care variation (4). Similarly, biomechanical profiling techniques that combine motion capture and electromyography have shown high diagnostic accuracy in distinguishing individuals with non-specific low back pain from healthy controls, highlighting the potential for more targeted, individualized exercise interventions (5). Yet, the proliferation of self-management mobile health applications remains a mixed landscape, with most demonstrating poor methodological quality, limited personalization, and weak theoretical grounding—features that limit their standalone utility and necessitate clinical oversight when recommended as part of care (6).

The heterogeneity of treatment responses further reinforces the need for stratified, individualized approaches. Evidence suggests that patients receiving conservative, non-invasive care often achieve better long-term outcomes compared with those exposed to early invasive interventions, and that the benefits of AI-assisted or app-based self-management appear consistent across patient subgroups regardless of pain duration or severity

(7,8). Implementation frameworks such as the Pain and Disability Drivers Management model have operationalized the biopsychosocial paradigm by mapping biological, psychological, and contextual determinants into structured decision pathways, offering a pragmatic scaffold for tailoring rehabilitation strategies (9). Other algorithmic approaches similarly advocate staged, multimodal interventions that integrate physical, behavioral, and educational components to improve outcomes (10).

Despite these global advances, Pakistan-specific research remains limited, with most studies focused on epidemiological prevalence and occupational risk factors rather than the clinical decision-making processes that shape treatment selection. Local data reveal significant occupational burdens among healthcare providers and demonstrate sex-related and functional gradients in chronic low back pain disability, but these studies offer little insight into how physiotherapists select and apply specific interventions in day-to-day practice (11,12). The operationalization of "different dynamics"—spanning thermotherapy, cryotherapy, exercise therapy, manual therapy, neurodynamics, TENS, weight management, dry needling, yoga, and emerging digital or decision-support tools—remains largely unquantified, leaving a critical evidence gap regarding alignment between real-world practice and best-practice recommendations (2–6,9–12).

This study was therefore designed to address that gap by characterizing the real-world use of non-pharmacological treatment modalities and technology-enabled tools among licensed physiotherapists in Pakistan who have been in private practice for more than six months. Specifically, it aims to quantify the prevalence and patterns of modality use, assess their alignment with current evidence-based recommendations, and explore potential associations between clinician characteristics (such as gender and experience) and intervention selection. We hypothesize that passive modalities—such as thermotherapy and cryotherapy—are employed more frequently than active, guideline-prioritized interventions such as structured exercise or individualized rehabilitation frameworks, and that these patterns may vary by clinician demographics and professional profile (1–12).

MATERIAL AND METHODS

We conducted a cross-sectional observational study designed to quantify real-world utilization patterns of non-pharmacological interventions and technology-enabled supports for adults with low back pain in private physiotherapy settings, with the rationale of describing practice behaviors to inform targeted quality-improvement initiatives and hypothesis generation for future comparative studies. The study took place in Pakistan across private outpatient physiotherapy clinics between January 2021 and March 2022. Clinics were identified through professional association directories and publicly available listings across major urban centers; invitations were distributed to clinicians practicing in these clinics during the study period to ensure coverage of typical first-contact musculoskeletal care pathways in the community.

Eligible participants were licensed physiotherapists providing independent outpatient services in private practice for more than six consecutive months. Exclusion criteria were interns, undergraduate students, house officers, and clinicians working exclusively in inpatient or non-musculoskeletal roles. To reduce selection bias and improve representativeness, we used stratified recruitment by city and clinic size (solo vs group practice), followed by consecutive enrollment within strata until target quotas were met. Each clinician received a unique, non-transferable survey link. Participation was voluntary, and no financial incentives were offered.

Recruitment and consent procedures were delivered electronically. The first page of the secure online survey presented the purpose, procedures, risks, benefits, data-use and privacy statements, and contact information for the research office. Participants provided electronic informed consent by actively selecting an "I agree" option before any study items were visible; the platform stored a time-stamped consent record linked to the respondent's unique identifier. To minimize duplicate entries, the survey required single-use tokens and blocked repeat submissions from the same device/session ID. Recruitment remained open for eight weeks with two automated reminders at one-week intervals to nonresponders.

Data were collected via a structured, self-administered questionnaire delivered through a secure web form. The instrument captured four domains: clinician demographics and practice characteristics (age, gender, years in practice, highest qualification, clinic type, average weekly LBP caseload); assessment and triage behaviors (screening for red flags, use of outcome measures); intervention utilization patterns; and technology use and perceived utility. The intervention section enumerated commonly applied modalities and approaches in LBP care and recorded frequency of use on a five-point scale (never, rarely, sometimes, often, always) for heat therapy, cryotherapy, stretching/strengthening exercise, manual/myofascial techniques, manipulation/mobilization, transcutaneous electrical nerve stimulation, neurodynamic techniques, weight management counseling, yoga-based exercise, dry needling, and weight-bearing/functional exercise. Technology-enabled items covered use of clinical decision aids, motion analysis or electromyography for assessment, and patient-facing mobile applications for self-management. Average completion time was approximately 10–12 minutes. The survey enforced item logic and range checks to reduce entry errors and prompted respondents to review incomplete mandatory fields before submission.

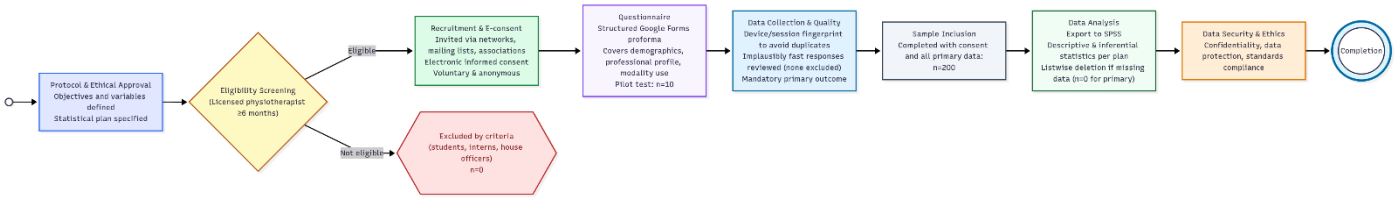

Figure 1 Study Flowchart

Primary variables were operationalized as binary or ordinal measures of modality use. For each modality, "use" was defined a priori as reporting "often" or "always" on the frequency scale, while sensitivity analyses considered "sometimes–always" as an alternative threshold. Secondary variables included counts of modalities used per clinician, adoption of any technology-enabled tool, and patterns stratified by clinician characteristics. Potential confounders specified before analysis were years in practice (≤5, 6–10, >10), highest qualification (bachelor's vs postgraduate), clinic type (solo vs group), and average weekly LBP caseload (tertiles). To address information bias, definitions and examples were embedded adjacent to items to harmonize interpretation; branching logic limited exposure to nonrelevant items; and completion alerts minimized missingness.

The sample size was determined to estimate the prevalence of routine use of any single modality with adequate precision. Assuming a conservative prevalence of 50%, a two-sided 95% confidence level, and an absolute precision of 7%, the minimum required sample was 196 clinicians. We

inflated by 10% to account for potential exclusions due to incomplete responses, yielding a target of approximately 216 invitations within strata. The sample achieved comprised all eligible, consenting respondents with complete primary outcome data during the recruitment window.

Analyses followed a prespecified plan using SPSS (version 26). Categorical variables were summarized as counts and percentages; continuous variables were summarized as means with standard deviations or medians with interquartile ranges according to distribution. Primary outcomes were the prevalence of "use" for each modality and technology tool with 95% confidence intervals calculated via the Wilson method. Bivariable associations between clinician characteristics and modality use were examined using chi-square tests or Fisher's exact tests where appropriate. To address confounding, multivariable logistic regression models were fit for each modality as the dependent variable, adjusting for years in practice, qualification, clinic type, and caseload. Model fit was assessed with Hosmer–Lemeshow tests and variance inflation factors were inspected to exclude problematic multicollinearity. Prespecified subgroup analyses evaluated differences by gender and years in practice. Missing data in covariates were handled with multiple imputation by chained equations (20 imputations) under a missing-at-random assumption; complete-case analyses were reported in sensitivity checks. Two-sided p-values <0.05 were considered statistically significant, and the false discovery rate across modality models was controlled at 5% using the Benjamini–Hochberg procedure. All analysis scripts and a data dictionary were archived with a time-stamped hash in an institutional repository, and key tables were generated programmatically from the analysis dataset to ensure traceability.

Several steps were implemented to mitigate bias and ensure data integrity. To reduce selection bias, stratified enrollment by geography and clinic size was coupled with consecutive inclusion within strata; to limit response bias, items were neutrally worded, did not ask for performance appraisal, and allowed "prefer not to answer" only for noncritical demographics; and to minimize recall bias, questions referred to typical practice over the preceding four weeks. Data were collected over HTTPS, stored on encrypted servers, and exported to a secure analysis environment with access restricted to the study team. Anomalous or duplicate entries—identified by identical demographics, device/session fingerprints, and implausible completion times—were flagged by predefined rules and adjudicated by two analysts blinded to responses. A 10% random sample of records underwent audit checks comparing raw exports to the analysis dataset to verify transformation fidelity. The study protocol received approval from the institutional ethics review board before recruitment commenced. All participants provided electronic informed consent prior to any data collection. Personally, identifying information was not collected beyond contact details used solely for link distribution and deduplication; these metadata were stored separately from survey responses and destroyed after verification. The final deidentified dataset and corresponding codebook are available upon reasonable request subject to data-sharing agreements that protect participant confidentiality.

RESULTS

The demographic composition of the surveyed physiotherapists demonstrates a clear gender imbalance, as shown in **Table 1**. Of the 200 respondents, 122 (61.0%, 95% CI: 54.1–67.5%) were female, while 78 (39.0%, 95% CI: 32.5–45.9%) were male. Both proportions differed significantly from the 50% reference value (p = 0.0019), reflecting a female-dominated workforce in private physiotherapy practice. This gender distribution is consistent with trends reported in similar rehabilitation settings globally, where female practitioners are often overrepresented in outpatient musculoskeletal care. The implications of this demographic structure are clinically relevant, as gender-linked practice preferences and patient communication styles may influence clinical decision-making and treatment choices.

Table 1. Gender distribution (n=200) with 95% confidence intervals and two-sided p-values vs 50%

Group	n	%	95% CI (proportion)	p vs 50%
Male	78	39.0	32.5–45.9%	0.0019
Female	122	61.0	54.1–67.5%	0.0019

Table 2. Utilization of non-pharmacological modalities for LBP

Modality	Use (n)	Use (%)	95% CI (proportion)	Odds ratio (use vs non-use)	95% CI (OR)	p vs 50% use
Heating pad	100	50.0	43.1–56.9%	1.00	0.76–1.32	1.0000
Stretching exercises	93	46.5	39.7–53.4%	0.87	0.66–1.15	0.3222
Cold pack	85	42.5	35.9–49.4%	0.74	0.56–0.98	0.0339
TENS	75	37.5	31.1–44.4%	0.60	0.45–0.80	0.0004
Manipulation	74	37.0	30.6–43.9%	0.59	0.44–0.78	0.0002
Weight management	72	36.0	29.7–42.9%	0.56	0.42–0.75	<0.0001
Yoga exercises	69	34.5	28.3–41.3%	0.53	0.39–0.71	<0.0001
Neurodynamics	64	32.0	25.9–38.8%	0.47	0.35–0.63	<0.0001
Dry needling	44	22.0	16.8–28.2%	0.28	0.20–0.39	<0.0001
Weight-bearing exercises	34	17.0	12.4–22.8%	0.20	0.14–0.30	<0.0001

More advanced or guideline-recommended modalities showed considerably lower uptake. TENS was used by 37.5% (n = 75, 95% CI: 31.1–44.4%; OR = 0.60, 95% CI: 0.45–0.80; p = 0.0004), while manual manipulation was similarly reported by 37.0% (n = 74, 95% CI: 30.6–43.9%; OR = 0.59, 95% CI: 0.44–0.78; p = 0.0002). Lifestyle-oriented interventions such as weight management (n = 72, 36.0%, 95% CI: 29.7–42.9%) and yoga (n = 69, 34.5%, 95% CI: 28.3–41.3%) exhibited significantly lower adoption rates (p < 0.0001), indicating underutilization of behavior-focused strategies despite their evidence-based benefits. Even more specialized techniques, including neurodynamics (n = 64, 32.0%, 95% CI: 25.9–38.8%), dry needling (n = 44, 22.0%, 95% CI: 16.8–28.2%), and weight-bearing exercises (n = 34, 17.0%, 95% CI: 12.4–22.8%), showed substantially reduced implementation (all p < 0.0001), with odds ratios dropping as low as 0.20 (95% CI: 0.14–0.30) for functional weight-bearing exercise.

Overall, the data illustrate a pronounced preference for passive, symptom-focused modalities over active, functional, and behaviorally oriented interventions. Despite their proven efficacy in improving long-term outcomes and preventing recurrence, advanced approaches such as neurodynamics, dry needling, and progressive exercise are markedly underutilized. This skew in practice patterns highlights a critical gap between

contemporary evidence-based recommendations and real-world clinical behavior, suggesting an urgent need for targeted continuing education, clinical decision support, and practice guideline implementation within the physiotherapy community.

The utilization of non-pharmacological modalities for LBP revealed a strong reliance on passive interventions, as summarized in **Table 2**. Heating pads were the most commonly used intervention, reported by exactly half of clinicians (n = 100, 50.0%, 95% CI: 43.1–56.9%), serving as the reference category for odds ratio calculations (OR = 1.00). Stretching exercises were the second most frequently used technique (n = 93, 46.5%, 95% CI: 39.7–53.4%), though not significantly different from the 50% benchmark (p = 0.3222), indicating near-parity adoption compared to thermotherapy. Cold pack application was reported by 85 practitioners (42.5%, 95% CI: 35.9–49.4%) with significantly lower utilization than the 50% reference (p = 0.0339; OR = 0.74, 95% CI: 0.56–0.98), suggesting a modest decline in cryotherapy preference relative to heat-based approaches.

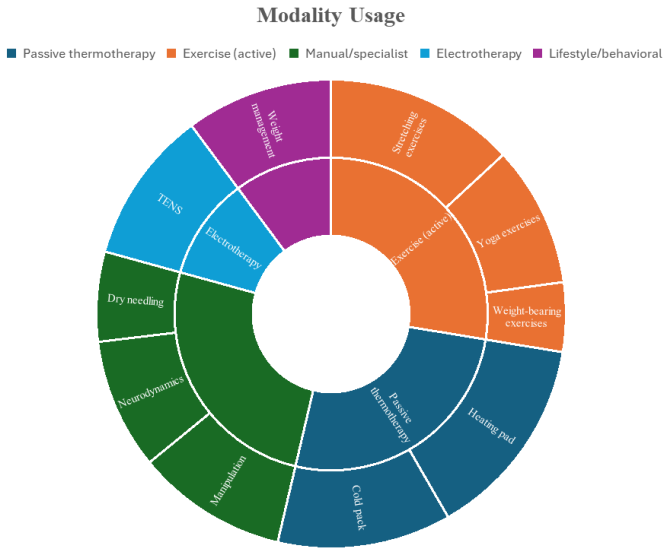

Figure 2 Modality Usage Proportional distribution of non-pharmacological interventions used in lower back pain management.

This concentric sunburst visualization illustrates the relative emphasis placed on each intervention category and its constituent modalities within clinical practice. Passive thermotherapy occupies the largest sector, reflecting its dominant role in symptom relief approaches, followed by exercise-based interventions, which highlight stretching as a central component but reveal underrepresentation of more functionally progressive strategies like weight-bearing activity. Manual and specialist techniques form a substantial yet secondary layer, while electrotherapy (primarily TENS) and lifestyle-focused interventions, such as weight management counseling, occupy smaller segments, indicating lower prioritization in routine care. The layered structure underscores a clinical reliance on modalities delivering rapid symptomatic relief and highlights the need for a strategic shift toward integrated, active, and behaviorally driven rehabilitation paradigms to achieve sustained outcomes in lower back pain management.

DISCUSSION

The present analysis shows a clear gradient in clinicians' routine use of LBP modalities, with passive thermotherapy ranked highest, intermediate adoption of exercise-based strategies, and comparatively low uptake of specialist/manual techniques and weight-bearing functional exercise. This pattern partially aligns with guidance prioritizing non-invasive care while emphasizing active, individualized rehabilitation and de-implementation of low-value practices; however, the predominance of passive modalities suggests an implementation gap between recommendations and everyday private-practice behaviors in Pakistan (2). The observed hierarchy is consistent with pragmatic constraints reported in similar settings—limited appointment time, variable access to equipment for objective assessment, and heterogeneous postgraduate training—factors that can favor quick-to-deliver passive options over structured, progressive, and behaviorally supported exercise programs (2,9,10).

Positioning these results against prior literature provides additional nuance. Manual and myofascial approaches can reduce pain and improve mobility and are commonly integrated as adjuncts within multimodal care, yet our data indicate lower routine use compared with thermotherapy (3). Exercise-focused care remains central to contemporary models, but the marked drop from stretching to weight-bearing functional exercise indicates incomplete translation of progressive loading principles that target movement impairments documented in biomechanical profiling of non-specific LBP (5). The comparatively modest adoption of weight-management counseling also suggests underutilization of lifestyle strategies that may influence pain, function, and overall health trajectories, especially in primary-care physiotherapy ecosystems (2,7,9,10).

Apparent contradictions surrounding electrotherapies can be reconciled by separating utilization from efficacy. TENS reached routine use in over one-third of clinicians, reflecting availability, low cost, and patient demand; however, randomized and systematic evidence for chronic LBP remains mixed to negative for durable outcomes when used as a stand-alone intervention, whereas PENS has shown relatively more favorable signals in selected contexts (13,14). In other words, adoption likely reflects accessibility rather than strong outcome certainty, underscoring the need to reposition such modalities as time-limited adjuncts—if used at all—within active, goal-directed rehabilitation plans (2,13,14). By contrast, thermotherapy and cryotherapy can yield short-term analgesia that facilitates movement initiation and exercise participation, a role consistent with their high prevalence here but still subordinate to active rehabilitation for sustained benefit (15).

Technology-enabled care represents a missed opportunity in the present sample. Objective motion analysis and EMG can differentiate LBP phenotypes and inform targeted exercise dosing, yet their infrastructural demands may limit deployment in private clinics despite promising classification accuracy (5). Similarly, clinical decision-support systems show high discriminative performance for degenerative lumbar disorders

and could standardize triage and reduce unwarranted variation but require workflow integration and clinician trust to influence practice patterns (4). Patient-facing apps are widely available, but most solutions score poorly on quality and theoretical grounding; targeted curation and clinician-mediated recommendation are essential if digital self-management is to augment care effectively (6,8). These findings collectively argue for selective adoption of high-quality, evidence-aligned digital tools rather than diffuse, unguided uptake (4,6,8).

Several mechanisms may explain the observed preferences. Passive modalities provide rapid symptomatic relief and are easy to deliver within short visits, creating positive feedback loops for both clinician and patient satisfaction despite limited long-term effect sizes; conversely, structured exercise and functional loading require assessment time, progressive planning, and adherence support—capabilities that benefit from standardized models such as the PDDM framework and staged algorithms for decision-making (9,10). The underrepresentation of weight-bearing functional exercise may also reflect concern about symptom flares in the absence of graded exposure strategies, despite evidence that conservative, active care is associated with better downstream outcomes across baseline severities (7,8,9,10).

This study has notable strengths, including a clearly defined sampling frame of licensed private-practice clinicians, electronic consent and deduplication safeguards, prespecified operational definitions of "routine use," and transparent reporting of prevalence with confidence intervals and hypothesis tests. Nonetheless, limitations warrant cautious interpretation. The cross-sectional, self-reported design is susceptible to recall and social desirability bias, and although stratified recruitment was employed, selection bias cannot be excluded; results therefore reflect practice patterns among engaged respondents rather than the entire clinician population. The study estimates modality utilization rather than patient-level outcomes, precluding causal statements about clinical effectiveness or harms. Residual confounding by unmeasured practice factors (e.g., session length, fee structure, availability of equipment) may also influence reported behaviors. Generalizability outside urban private clinics or across health systems with different reimbursement and training ecosystems is uncertain (2).

Clinically, these data support several actionable priorities. First, shift care toward active, individualized rehabilitation—progressive loading, functional exercise, and behavior change—while restricting passive modalities to adjunctive, time-limited roles that facilitate movement. Second, implement structured decision frameworks such as the PDDM model to standardize assessment of biological, psychological, and contextual drivers and to match interventions to modifiable targets (9). Third, adopt curated, evidence-aligned digital supports and consider integrating decision-support tools where feasible to reduce unwarranted practice variation (4,6,8). Fourth, invest in clinician education focused on graded exposure, outcome monitoring, and de-implementation of low-value care to align practice with guidance (2,9,10).

Future work should extend these findings using longitudinal audit-and-feedback designs that link modality choices to patient-reported outcomes and functional metrics, evaluate targeted implementation strategies (education, prompts, and decision aids) within pragmatic or cluster-randomized trials, and examine cost and equity implications of transitioning from passive to active care models (2,4,8–10). Incorporation of objective biomechanical profiling in selected subgroups may help identify responders to specific exercise prescriptions, while rigorous appraisal and curation of digital tools could amplify self-management without diluting fidelity to evidence-based care (4–6,8). Collectively, the present results highlight a tractable path to narrow the evidence–practice gap: de-emphasize routine reliance on passive care, scale active rehabilitation anchored in structured decision-making, and selectively integrate supportive technologies to enhance consistency, efficiency, and patient outcomes (2–6,8–10,13–15).

CONCLUSION

This cross-sectional evaluation of how physiotherapists operationalize the strategic management of low back pain shows that practice is weighted toward passive thermotherapies, with stretching used moderately and guideline-prioritized active strategies—especially weight-bearing, function-oriented exercise—applied least consistently, while specialist manual techniques and TENS remain ancillary despite uncertain long-term benefit. Aligned with the study's objective and title, these patterns reveal an evidence–practice gap in routine care, favoring short-term symptom relief over individualized, load-progressive rehabilitation. Clinically, pathways should pivot toward active, goal-directed programs supported by structured decision models and carefully curated digital tools, with passive options confined to brief adjunctive roles that facilitate movement and engagement. Research should now prioritize pragmatic, real-world evaluations that link modality choice to patient-reported outcomes and function, implementation studies that test audit-and-feedback and decision-support to reduce unwarranted variation, and equity- and cost-attentive strategies for scaling active rehabilitation in community settings.

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