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COMPARATIVE EFFECTIVENESS OF COMBINATION OF SOFT TISSUE MOBILIZATIONS, MAITLAND'S MOBILIZATIONS AND STRETCHING VS CONVENTIONAL CARE ON ANTERIOR PELVIC TILT, PAIN, AND QUALITY OF LIFE AMONG INDIVIDUALS WITH NON-SPECIFIC LOW BACK PAIN; A RANDOMIZED CONTROLLED TRIAL

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Abstract

Background: Non-specific low back pain (NSLBP) is a prevalent musculoskeletal disorder strongly associated with anterior pelvic tilt (APT) and impaired quality of life. Traditional unimodal physiotherapy approaches often yield limited benefits.

Objective: To evaluate the comparative effectiveness of a multimodal physiotherapy program, soft tissue mobilization (STM), manual therapy (MM), and stretching, versus conventional care in improving pain (NPRS), pelvic alignment (APT), and health-related quality of life (SF-36).

Methods: Fifty participants with NSLBP and confirmed APT were randomized into an intervention group (STM, MM & Stretching, n = 25) or control (Conventional Physiotherapy, n = 25). Interventions were delivered twice weekly for four weeks. Outcomes included NPRS, APT angle (digital photography), and SF-36, measured at pre, mid, and post-intervention.

Results: The intervention group showed significantly greater improvements in pain (NPRS: –4.68 points, $p < 0.001$), pelvic alignment (APT: –5.34°, $p < 0.001$), and multiple SF-36 domains, with large effect sizes in Physical role limitation ($\eta^2 = 0.238$), Social Functioning ($\eta^2 = 0.219$), Pain ($\eta^2 = 0.202$), and General Health ($\eta^2 = 0.167$). No significant baseline demographic differences were observed between groups.

Conclusion: A multimodal physiotherapy program combining soft tissue mobilization (STM), manual therapy, and stretching provides clinically significant benefits in pain, pelvic alignment, and quality of life among patients with NSLBP. This supports integrative rehabilitation strategies for biomechanical and psychosocial recovery.

Trial Registration: The study clinical trial has been registered at PRS clinical trial registry USA on 1st August 2025 (ID: NCT07098741).

Keywords: Non-specific low back pain; anterior pelvic tilt; soft tissue mobilization; manual therapy; stretching; SF-36; randomized controlled trial.

INTRODUCTION

Non-specific low back pain (NSLBP) remains the leading cause of years lived with disability worldwide and affects well over half a billion people at any given time. Global estimates suggest 619 million people were living with low back pain in 2020, with projections reaching ~843 million by 2050, underscoring the scale and persistence of the problem and the need for effective, scalable conservative care (GBD Low Back Pain Collaborators, 2021).
Among the many biomechanical contributors proposed for subgroups of NSLBP, lumbopelvic alignment, especially anterior pelvic tilt (APT), has received increasing attention. Recent clinical and observational work reports that pelvic-tilt imbalance is associated with higher disability and altered hip range of motion in people with NSLBP, while a contemporary systematic review indicates pelvic tilt may differ between people with or without LBP but stresses that heterogeneity limits firm conclusions. Together, these findings support studying targeted, mechanism-informed treatments while acknowledging uncertainty in causal pathways (Kim and Shin, 2023; Sugavanam et al, 2025).
Within NSLBP, lumbopelvic alignment, particularly anterior pelvic tilt (APT), has gained attention as a clinically relevant phenotype. Cross-sectional and cohort studies indicate that pelvic tilt influences hip–spine alignment and may be associated with NSLBP-related disability and hip range limitations. While causality remains debated, recent syntheses suggest pelvic tilt angle can be greater in people with LBP, justifying trials that target this mechanistic pathway (Kim and Shin, 2023).
Accurate, repeatable measurement of APT is feasible in clinical settings. Digital pelvic inclinometers and caliper-based devices (e.g., PALM) show good intra- and inter-rater reliability and acceptable agreement with radiographic surrogates; photogrammetry/digital photography methods also demonstrate high test–retest reliability when standardized. These methods allow APT to be used as a primary mechanistic outcome alongside patient-important endpoints (Suits, 2021; Lin et al, 2024).
Beyond posture, pain and health-related quality of life (HRQoL) are central to the lived experience of NSLBP. The SF-36 is widely used across chronic pain and spine populations, with robust psychometric support for its physical (PCS) and mental (MCS) components and established responsiveness in NSLBP cohorts. This makes SF-36 an appropriate HRQoL endpoint alongside pain intensity (NPRS/VAS) (LoMartire et al, 2020).
There is growing evidence that manual therapies directed at soft tissue and segmental joints can augment outcomes when paired with exercise or flexibility work. Myofascial release (MFR) meta-analyses report improvements in pain and function in chronic LBP (albeit with heterogeneity and variable certainty), supporting soft-tissue approaches as part of multimodal care (Wu et al, 2021; Chen et al, 2021).
For the joint component, lumbar postero–anterior (PA) mobilization, a core Maitland technique, has demonstrated immediate and short-term analgesic effects and range gains in NSLBP in clinical trials. These effects plausibly operate via segmental mechanoreceptor stimulation, hypoalgesia, and stiffness reduction, thereby enabling more effective movement retraining and stretching (Shah and Kage, 2016; Shum et al, 2013).
On the flexibility side, targeted stretching of the hip flexors (iliopsoas/rectus femoris) and other anterior-chain tissues can influence lumbopelvic mechanics. Experimental and clinical studies show that hip-flexor–biased or posterior-pelvic-tilt stretching strategies measurably alter pelvic tilt and reduce hip flexor loading; hamstring stretching can also modify pelvic tilt in people with LBP when shortness is present. Together, these findings support a mechanism-informed package that addresses both soft-tissue compliance and joint hypomobility to reduce APT (González-de-la-Flor et al, 2024; Preece et al, 2021; Shamsi et al, 2020).
"Conventional" NSLBP care in many outpatient settings often includes superficial heat, non-specific ROM exercises, advice, and, variably, Transcutaneous Electrical Nerve Stimulation (TENS). Contemporary WHO guidelines for chronic primary LBP emphasize education, structured exercise, and biopsychosocial, multicomponent care; they do not recommend the routine use of TENS, therapeutic ultrasound, traction, or lumbar braces given very low-to-moderate certainty of benefit. This context highlights the importance of testing targeted, mechanism-based packages against locally prevalent usual care to inform practice (WHO, 2023).
Manual treatments that address myofascial restrictions (soft-tissue mobilization/myofascial techniques) and joint mechanics (manual therapy) alongside targeted stretching are biologically plausible ways to influence APT and pain. Experimental studies show hip-flexor or hamstring stretching can reduce APT or related demands, with trials demonstrating immediate or short-term changes in pelvic tilt or hip flexor loading. These effects suggest stretching may modify lumbopelvic posture in ways relevant to pain and function (González-de-la-Flor et al, 2024; Preece et al, 2021; Shamsi et al, 2020). There is also growing evidence that manual therapy (MM) used as an adjunct to exercise improves outcomes in NSLBP. A meta-analysis of myofascial release reported meaningful improvements in pain and physical function in chronic LBP, and a recent systematic review concluded that adding MM to exercise yields greater short-term improvements in pain and disability than exercise alone. An RCT further found that MM preceding core exercise accelerated early disability gains versus exercise alone; consistent with a multimodal strategy that first reduces soft-tissue and joint restrictions to enable more effective exercise (Wu et al 2021; Narenthiran et al, 2025).
Despite the high burden of NSLBP and plausible links between lumbopelvic mechanics and symptoms, few randomized trials have tested whether combining STM/MM with directed stretching produces superior improvements

in APT (as a mechanistic target), pain, and HRQoL compared with conventional physiotherapy. Prior literature signals potential benefit but remains heterogeneous, particularly around posture-related constructs like APT, highlighting the need for rigorously designed RCTs that include posture-specific endpoints. Conducting this trial in South Punjab (Pakistan) addresses a clear evidence gap: there is little region-specific, randomized evidence on conservative NSLBP care, yet local practice patterns, patient characteristics, and access to services can shape outcomes and implementation. By (i) targeting APT with a combined STM/MM+stretching protocol, (ii) using reliable pelvic-tilt measurement methods alongside patient-important outcomes (pain, SF-36), and (iii) recruiting in South Punjab, this study will offer locally relevant, mechanistic and clinical evidence to guide physiotherapy for NSLBP in the region.[16]

METHODOLOGY

Study design and setting

A single-center, parallel-group, randomized controlled trial (1:1 allocation) was conducted at the Physiotherapy Department, National Orthopedic & General Hospital, Bahawalpur (NOGH-BWP), South Punjab, Pakistan**.** The study commenced from 20th June 2025 and was completed on 15th August, 2025 The study compares a combination of Soft-Tissue Mobilization, Maitland's Mobilizations and targeted Stretching (STM+MM+Stretching) with Conventional Physiotherapy (usual care) among adults with non-specific low back pain (NSLBP) and increased anterior pelvic tilt (APT) angle**.**

Sample size

Sample size was calculated using G*Power v3.1 software for a two-arm repeated-measures design with $\alpha=0.05$ and $1-\beta=0.80$ indicated $n\approx46$ for detecting a small-to-moderate interaction effect. To accommodate potential attrition (≈5–10%), the target sample is n=50 (25/group)**.**

Inclusion criteria

Participants were adults aged 20–40 years, of any gender, with clinically confirmed non-specific low back pain (NSLBP) characterized by altered lumbar posture and range-of-motion restriction attributable to muscular spasm, and an altered anterior pelvic tilt (APT) established by a qualified healthcare professional using standardized criteria (with imaging only where clinically indicated). APT was verified by a trained examiner using digital inclinometers or goniometers as detailed in the outcomes protocol.

Exclusion criteria

Individuals were excluded if they have a history of trauma or fracture involving the pelvis or lumbar region; prior orthopedic or neurological surgery to the pelvis or lumbar spine; known malignancy; autoimmune disorders affecting musculoskeletal function; referred or radiating visceral pain; gait abnormalities or neurological disorders that impair musculoskeletal function; congenital or developmental musculoskeletal disorders; pregnancy; contraindications to study modalities (e.g., electrotherapy); inability to attend scheduled sessions; cognitive or communication impairments that preclude adherence; or current participation in other interventional research (e.g., trials for myofascial pain syndrome or radiculopathy).

Recruitment and screening

Participants were recruited from outpatient clinics and referral sources at NOGH-BWP. A trained physiotherapist screened eligibility, obtained consent, and performed baseline assessments prior to randomization.

Randomization, allocation concealment, blinding

Computer-generated random sequence (1:1), variable block sizes (e.g., 4–6), prepared by an independent researcher not involved in enrollment or treatment. Sequentially numbered, opaque, sealed envelopes (SNOSE) or centralized phone/text randomization to ensure concealment until assignment. Due to the nature of interventions, therapists and participants could not be blinded. However, outcome assessors and the statistician were blinded to group allocation. Participants will be instructed not to disclose their group to assessors.

Interventions

Group A: STM, Maitland's Mobilizations, & Stretching

Delivered by licensed physiotherapists using standardized SOPs as follows:

Soft Tissue Mobilization

Sessions began with soft-tissue mobilization (STM) and trigger point therapy using ischemic compression over the lumbar paraspinals, thoracolumbar fascia, and quadratus lumborum, with gluteal/piriformis treated as indicated. Pressure was increased gradually to the patient's pressure pain threshold, held 30–60 s, released 10–15s, and repeated for 3–5 cycles per point, followed by 5–8 min of general STM (effleurage/stripping) to modulate nociception and prepare tissues for joint work. Ischemic compression has immediate to short-term benefits for pain, pressure-pain threshold, and range of motion in myofascial pain, while massage/STM shows small–moderate short-term improvements in chronic low back pain within comparative effectiveness reviews.[17,18] Myofascial release (MFR) was applied using cross-hand or direct sustained loads to thoracolumbar fascia/lumbar paraspinals (90–120 s per hold, 2–3 holds/region). Contemporary evidence suggests MFR can reduce disability in chronic low back pain as an adjunct to exercise/physical therapy, though pain effects are mixed across reviews; hence its use here as a supportive, not stand-alone, component (Chen et al, 2021).

Maitland's Mobilization

Lumbar joint mobilization is performed in prone (pillow under abdomen if needed) using Maitland grades I, II & III posterior-to-anterior pressures (central/unilateral). Grades I–II are applied for irritable pain (small/large-amplitude oscillations within initial–mid range), progressing to grade III for stiffness-dominant presentations (large-amplitude into end-range). Dosing targets 1–2 Hz oscillations for 3 bouts × 45–60 s per symptomatic segment with brief rests, progressing by irritability. Randomized and mechanistic studies support PA mobilization (often combined with extension exercises) for pain, function, and physiologic disc hydration changes in nonspecific low back pain (Shah et al, 2016).

Stretching

APT-focused stretching targets iliopsoas, rectus femoris, and Tensor of Fascia Lata / IT Band, dosed at 3×30–45 s per selected muscle (2–3 sets where noted) with ~15 s rests; hamstrings were stretched only if objectively short to avoid excessive posterior pelvic tuck. A daily home program (8–10 min) reinforces clinic gains and adherence is checked each session. Evidence links hip flexor tightness with increased anterior pelvic tilt/lumbar lordosis, and trials show that specific hip-flexor stretching can improve hip extension and related lumbopelvic alignment parameters. Guidance documents on pelvic-tilt assessment also support targeting modifiable contributors like hip flexor length during rehabilitation (Suits, 2021, Lin et al, 2024).

Group B: Control Group

Control Group: combination of electrotherapy (Infra-red) with stretching and flexibility exercises group.

Electrotherapy: Infra-red position of the lamp was approximately 12 to 18 inches away from the affected area, ensuring that the light is directed at the lower back. Before starting the treatment, any clothing or coverings that may obstruct the light's penetration were removed. Lamp was turned on for about 15 to 30 minutes per session (Tsagkaris et al, 2022).

Stretching: Gentle stretching exercises; knee-to-chest, cat-cow, and pelvic tilts were performed actively by the patient at repetitions of 3-5 with a hold of 15seconds and were instructed to the patient to perform the same at home two times daily (Qaseem et al, 2017; Shnayderman et al, 2013).

Flexibility exercises: Patients were taught to perform hamstring stretches, hip flexor stretches, and lumbar rotations under observation at the clinic and perform at home as well two times daily (Gordon and Bloxham, 2016; Hayden et al, 2021).

Dose/frequency: 2 sessions/week for 4 weeks (8 sessions); ~20 min manual therapy + 10–12 min stretching.

Safety: Regress grades/pressure if pain peripheralizes or >7/10; screen red flags each visit.

Outcome Measures

1) Pelvic Tilt Angle

Digital photogrammetry with MicroDicom

For photogrammetric assessment of anterior pelvic tilt (APT), bilateral anterior superior iliac spines (ASIS) and posterior superior iliac spines (PSIS) were first palpated and lightly marked. Imaging was conducted against a neutral, matte background under consistent lighting to minimize glare. Participants stood barefooted on a standardized foot-placement template (stance width and toe-out recorded), arms crossed over the chest with eyes forward. A digital camera, mounted on a tripod at 0.90 m height and positioned 2.90 m from the participant with the lens level and plumb, captured lateral right and left views. Three images per side were acquired, with the participant instructed to exhale gently and relax before each capture. Images were imported into MicroDicom, where a line connecting the ASIS–PSIS markers was referenced against an absolute horizontal to compute APT (°) for each side. The mean of three trials per side was calculated, and the grand mean (averaged across right and left) was used for analysis (Bhutto et al, 2021). (Figure-I)

Standardization & blinding: All APT measurements were performed by the same blinded assessor, at the same time of day for each participant. Participants were ensured to avoid unusual activity or use of analgesics.

2) Pain Intensity (NPRS)

The Numeric Pain Rating Scale (NPRS) was an 11-point scale (0–10) anchored at 0 = no pain and 10 = worst pain imaginable. It is a valid, reliable, uni-dimensional measure of pain intensity in musculoskeletal conditions (Nugent et al, 2021).

3) Health-Related Quality of Life (SF-36)

The Short-Form 36 Health Survey (SF-36) assesses eight domains—Physical Functioning, Role-Physical, Bodily Pain, General Health, Vitality, Social Functioning, Role-Emotional, and Mental Health—with each transformed to 0–100 (higher = better health); domain scores were aggregated into Physical and Mental Component Summary scores (PCS/MCS) using standard scoring algorithms. Its psychometric strength in spine and chronic-pain populations is supported by recent work, including robust measurement properties in chronic-pain outpatients, reaffirming the two-component (physical/mental) structure[6], predictive validity of SF-36 subscales for 5-year disability in chronic low back pain (Lin et al, 2024).

Statistical Analysis
Analyses were run in SPSS v26 using repeated-measures ANOVA (or linear mixed-effects models if assumptions warranted) with fixed Group (2) × Time (3: T1, T2, T3) interaction. We report adjusted between-group differences with 95% CIs**,** partial η^2 (omnibus/interactions) and Cohen's d (pairwise), controlling multiplicity via Holm–Bonferroni**.**

RESULTS

Baseline Characteristics
Figure-II presents the demographic characteristics of participants in both groups. No statistically significant differences were observed in age, height, weight, or BMI (all $p > 0.05$), indicating baseline comparability across groups. This ensures that subsequent differences in clinical and quality-of-life outcomes can be attributed to the intervention rather than demographic variability.
The repeated measures ANOVA revealed a significant time effect across assessments ($F=143.19$, $p<.001$, $\eta^2=0.749$). The Group × Time interaction was highly significant ($F=92.23$, $p<.001$, $\eta^2=0.658$), showing that the intervention group experienced greater reductions in anterior pelvic tilt compared to the control group. The intervention group decreased from 17.51° (Pre) to 15.78° (Mid) and 14.09° (Post), while the control group remained relatively unchanged. (Table-I)
The repeated measures ANOVA indicated a strong time effect on pain reduction ($F=295.04$, $p<.001$, $\eta^2=0.860$). The Group × Time interaction was significant ($F=17.85$, $p<.001$, $\eta^2=0.271$), showing that the intervention produced greater pain relief compared to control. The intervention group reduced pain from 8.96 (Pre) → 6.76 (Mid) → 4.28 (Post), while the control group only decreased from 9.00 → 7.92 → 6.16. The between-group comparison confirmed superiority of STM, MM, and stretching ($p<.001$, $\eta^2=0.242$). (Table-II)
Table-III Comparative analysis of SF-36 domain scores between STM, MM & Stretching group and Control group at pre-, mid-, and post-intervention stages. Data are presented as Mean ± SD, with corresponding p-values and effect sizes (η^2). The STM, MM & Stretching group demonstrated significantly greater improvements across multiple domains, particularly in Role Physical, Social Functioning, and Pain, where effect sizes indicated clinically meaningful differences**.** Asterisks denote levels of statistical significance ($p < 0.05$; $p < 0.01$; $p < 0.001$).

Figure-III represents comparative trajectories of SF-36 domain scores (Physical Functioning, Role Physical, Role Emotional, Emotional Well-being, Social Functioning, Pain, and General Health) across pre-, mid-, and post-intervention assessments in the STM, MM & Stretching group versus Control. The intervention group showed significant improvements in most domains, particularly at post-intervention, with large effect sizes in Role Physical ($\eta^2 = 0.238$), Pain ($\eta^2 = 0.202$), and Social Functioning ($\eta^2 = 0.219$). The control group demonstrated only modest gains, while the intervention group achieved clinically meaningful and sustained increases across physical, psychosocial, and general health dimensions (all $p \leq 0.05$ at post).

DISCUSSION

In this randomized, two-arm trial conducted at National Orthopedic & General Hospital, Bahawalpur (South Punjab), Soft Tissue Mobilizations, Maitland's Mobilizations and targeted stretching (STM/MM+Stretching) produced greater improvements than conventional physiotherapy on all prespecified outcomes: pain intensity (NPRS)**,** anterior pelvic tilt (APT)**,** and health-related quality of life (SF-36 domains)**.** By T3 (post-intervention), the intervention group achieved **a** ~52% reduction in pain (−4.68/10 points), a ~20% reduction in APT (−3.42°), and clinically broad gains in SF-36 (with large effects in Role-Physical, Social Functioning, and Pain domains). These effects exceeded between-group differences observed at mid-treatment, indicating continued accrual of benefit across the four-week dose.
Placed against the global burden of non-specific low back pain (NSLBP), 619 million people affected in 2020 and projections to ~843 million by 2050, results of this trial reinforce the need for pragmatic, mechanism-informed, non-surgical care pathways that can be delivered in routine outpatient settings typical of low- and middle-income regions (GBD Low Back Pain Collaborators, 2021).
Contemporary syntheses suggest that myofascial release (MFR) improves pain and function in chronic LBP, although estimates vary by outcome and study quality. Our results, large improvements in pain and multiple SF-36 domains, align with meta-analytic signals that soft-tissue techniques can meaningfully augment conservative care, while acknowledging heterogeneity in literature (Wu et al, 2021; Chen et al, 2021).
For the joint component, posterior–anterior (PA) spinal mobilization has repeatedly demonstrated immediate hypoalgesic and mechanical effects in NSLBP, plausibly via segmental mechanoreceptor stimulation and stiffness reduction. The trajectory we observed (early pain reduction by Mid Intervention with further gains by Post Intervention) is consistent with trials showing acute analgesia and ROM benefits after PA mobilization, extended here to a four-week course within a multimodal package (Shum et al, 2013).

Targeted stretching and lumbopelvic mechanics. Mechanistic work indicates that hip-flexor–biased stretching **c**an influence pelvic orientation and lumbar curvature; more recent experiments using posterior-pelvic-tilt–oriented stretch strategies report reductions in hip flexor reactive forces, supporting the plausibility of the APT correction we observed. Our protocol's emphasis on iliopsoas/rectus femoris/TFL (with hamstrings only when short) accords with this literature and may explain the ~3.4° APT change (González-de-la-Flor et al, 2024; Preece et al, 2021).

While causality between APT and NSLBP remains debated, studies show pelvic-tilt imbalance is associated with disability, altered hip ROM, and pain in occupational cohorts with NSLBP. Our results add randomized evidence that targeting APT within a manual-plus-stretch paradigm can produce parallel improvements in symptoms and HRQoL (Kim and Shin, 2023).

We used standardized digital photogrammetry with ASIS/PSIS landmarks and a consistent camera setup; the underlying digital pelvic inclinometer/palpation-meter family of measures demonstrates moderate-to-excellent reliability and acceptable validity relative to radiographic surrogates. Treating APT as a primary mechanistic outcome is therefore supported by the psychometric literature (Suits, 2021).

The SF-36 instrument is well validated across chronic pain and spinal populations and responsive to clinical change. The breadth of domain improvements we observed (physical, social, role, and emotional domains) are concordant with SF-36's design to capture both physical and mental health impacts of pain conditions (Ware and Sherbourne, 1992).

Two complementary perspectives underscore clinical meaning: Magnitude vs minimal clinically important difference (MCID). MCID anchors for NPRS in musculoskeletal LBP commonly cluster around ~2 points over short horizons; our mean reduction of 4.68 points comfortably exceeds that threshold, suggesting patient-salient improvement (Childs et al, 2005). Alignment with guidance. The WHO guideline for non-surgical management of chronic primary LBP (2023) emphasizes multicomponent, non-pharmacological strategies (education, exercise, manual therapies in the context of active care) and cautions against routine use of modalities with low certainty. In a setting where "conventional care" often comprises heat, TENS, and generalized ROM, our findings support re-weighting care toward mechanism-informed manual with targeted flexibility approaches that deliver measurable gains in function and quality of life (WHO, 2023).

Our intervention plausibly acted through complementary pathways such as Hypoalgesia and stiffness modulation from PA mobilization (segmental mechanoreceptor activation, central pain modulation), enabling greater movement tolerance.[10] Fascial load and neuromyofascial tone normalization via MFR, which meta-analyses link to reductions in pain and disability; potentially enhancing subsequent joint/movement interventions.[7] Reduction of anterior pelvic moments through targeted anterior-chain flexibility (iliopsoas/rectus femoris/TFL) and posterior-pelvic-tilt–oriented strategies, shifting pelvic orientation toward neutral and decreasing lumbar extension bias (González-de-la-Flor et al, 2024; Preece et al, 2021).

The observed APT correction concurrent with pain and SF-36 gains suggests that posture-mechanics–symptom linkages, while multifactorial, are clinically exploitable in NSLBP subgroups displaying measurable APT.

Strengths and limitations

Strengths include (i) randomized allocation with assessor/statistician blinding; (ii) mechanistic primary endpoint (APT) with standardized acquisition; (iii) prespecified, patient-important outcomes (NPRS; SF-36); and (iv) a pragmatic dose (8 visits/4 weeks) consistent with typical outpatient access in South Punjab.

The single-center design may limit generalizability beyond similar outpatient populations. Therapist/participant blinding was not feasible, although assessor blinding was maintained. Follow-up ended at four weeks; durability of effects beyond this horizon is unknown. Finally, the comparator reflected locally prevalent "conventional" practice (heat/TENS/ROM) rather than guideline-optimized active programs; external settings using high-dose exercise/education comparators may yield smaller between-group deltas. These caveats map to concerns emphasized in guidelines and reviews about heterogeneity of usual care and the importance of active, multimodal programs (WHO, 2023).

Future research

Priorities include (1) longer-term follow-up to test durability and relapse; (2) head-to-head comparisons against exercise-dominant or education-enhanced programs recommended by guidelines; (3) mechanistic subtyping (e.g., irritability, hip-spine phenotype) to identify responders; (4) dose-response and sequencing (e.g., MFR/PA first vs stretching first); and (5) implementation studies across multiple centers in Pakistan to examine scalability and equity of access.

CONCLUSION

For NSLBP patients with anterior pelvic tilt, soft tissue mobilizations and Maitland's mobilizations with targeted stretching over four weeks generated clinically and statistically superior improvements in pain, APT angle, and multidomain quality of life compared with conventional physiotherapy. These findings support mechanism-informed manual and flexibility care as a pragmatic upgrade to usual practice and provide a foundation for scaled, guideline-aligned conservative management of NSLBP.[1,29]

Ethical Approval & Clinical Trial Registration

Ethical approval was obtained from the Institutional Review Board (Ref. No. NOGH/ERC/0125/012. The main study clinical trial has already been registered at the PRS clinical trial registry USA (ID: NCT07098741)

Conflict of Interest

Author declares no conflict of interest.

Table-I Comparison of Anterior Pelvic Tilt (APT) angle

Time Point	STM, MM & Stretching(n=25) Mean ± SD	Control Group (n=25) Mean ± SD	Mean Difference (95% CI)	p-value	Effect Size (η^2)
Pre-Intervention	17.51 ± 0.99	17.18 ± 1.67	+0.33 (–0.56, +1.22)	p = 0.460	–
Mid-Intervention	15.78 ± 0.80	17.09 ± 1.65	–1.31 (–2.07, –0.55)	p < 0.001	0.658
Post-Intervention	14.09 ± 1.02	16.80 ± 1.67	–2.71 (–3.52, –1.90)	p < 0.001	0.658
Overall Mean	15.79 ± 0.26	17.02 ± 0.26	–1.23 (–1.96, –0.51)	p = 0.001	0.196

Table -II Comparison of Numeric Pain Rating Scale (NPRS) scores

Time Point	STM, MM & Stretching (n=25) Mean ± SD	Control Group (n=25) Mean ± SD	Mean Difference (95% CI)	p-value	Effect Size (η^2)
Pre-Intervention	8.96 ± 0.68	9.00 ± 1.00	–0.04 (–0.61, +0.53)	p = 0.874	–
Mid-Intervention	6.76 ± 0.72	7.92 ± 1.44	–1.16 (–1.85, –0.47)	p < 0.001	0.271
Post-Intervention	4.28 ± 1.21	6.16 ± 1.43	–1.88 (–2.59, –1.17)	p < 0.001	0.271
Overall Mean	6.67 ± 0.19	7.69 ± 0.19	–1.03 (–1.55, –0.50)	p < 0.001	0.242

Table-III Comparative Table of SF-36 Domains Between Groups

Domain (SF-36)	STM, MM & Stretching (Mean ± SD)	Control Group (Mean ± SD)	p-value (Pre)	p-value (Mid)	p-value (Post)	Effect Size (η^2)
Physical Functioning	51.2 ± 11.83 → 57.4 ± 8.55 → 72.0 ± 7.21	49.4 ± 10.34 → 54.8 ± 6.68 → 63.2 ± 8.64	0.49	0.18	0.049	0.079
Role Physical	37.2 ± 9.02 → 49.6 ± 8.28 → 71.6 ± 9.75	35.2 ± 11.31 → 41.76 ± 10.33 → 53.44 ± 9.30	0.54	0.03	<0.001	0.238
Role Emotional	35.6 ± 7.12 → 46.2 ± 8.93 → 67.4 ± 6.94	35.4 ± 8.40 → 41.4 ± 10.25 → 50.0 ± 13.07	0.93	0.09	0.001	0.194
Emotional Well-being	37.8 ± 8.79 → 49.4 ± 11.57 → 68.8 ± 9.49	35.6 ± 12.93 → 41.2 ± 13.79 → 55.4 ± 10.59	0.52	0.04	0.007	0.143
Energy	37.4 ± 8.18 → 50.6 ± 8.58 → 72.8 ± 10.90	35.6 ± 9.61 → 45.8 ± 8.98 → 52.2 ± 9.58	0.48	0.06	<0.001	0.295
Social Functioning	40.8 ± 12.80 → 53.0 ± 8.89 → 68.0 ± 9.13	39.2 ± 11.52 → 42.0 ± 12.91 → 52.4 ± 10.21	0.68	0.01	0.001	0.219
Pain	23.8 ± 8.57 → 39.0 ± 6.45 → 60.6 ± 10.23	20.0 ± 7.22 → 31.2 ± 15.43 → 46.4 ± 15.51	0.16	0.04	0.001	0.202
General Health	34.6 ± 10.20 → 45.0 ± 9.46 → 70.0 ± 8.41	33.2 ± 12.40 → 41.6 ± 11.06 → 52.2 ± 11.55	0.73	0.21	0.003	0.167

Figure-I: APT measurement via MicroDicom

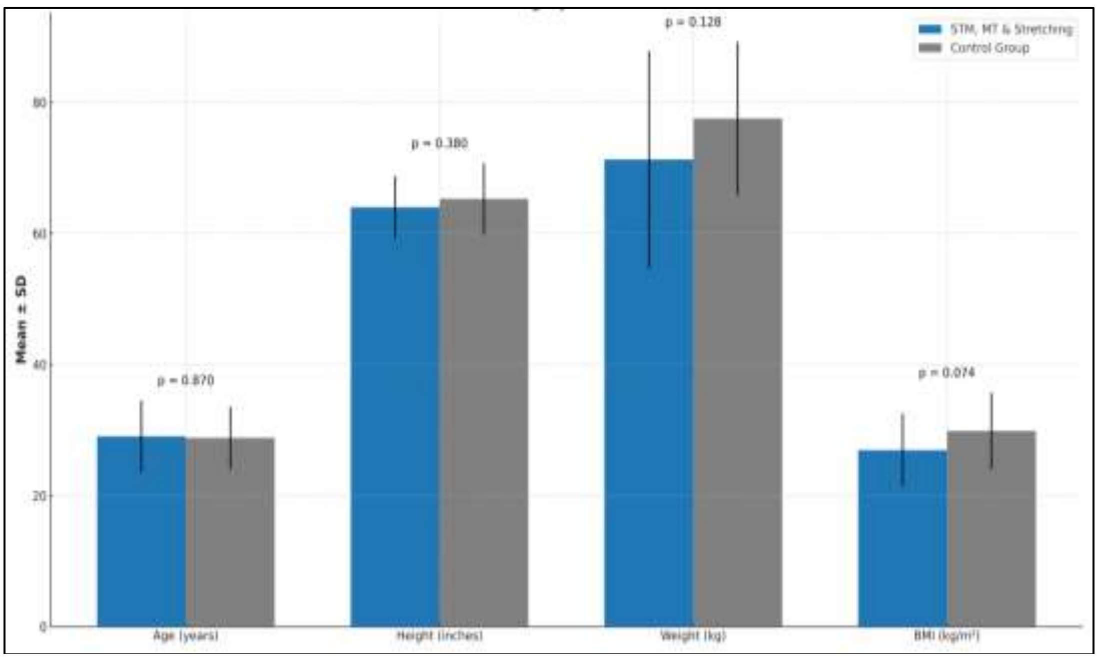

Figure-II: Demographic Characteristics of participants

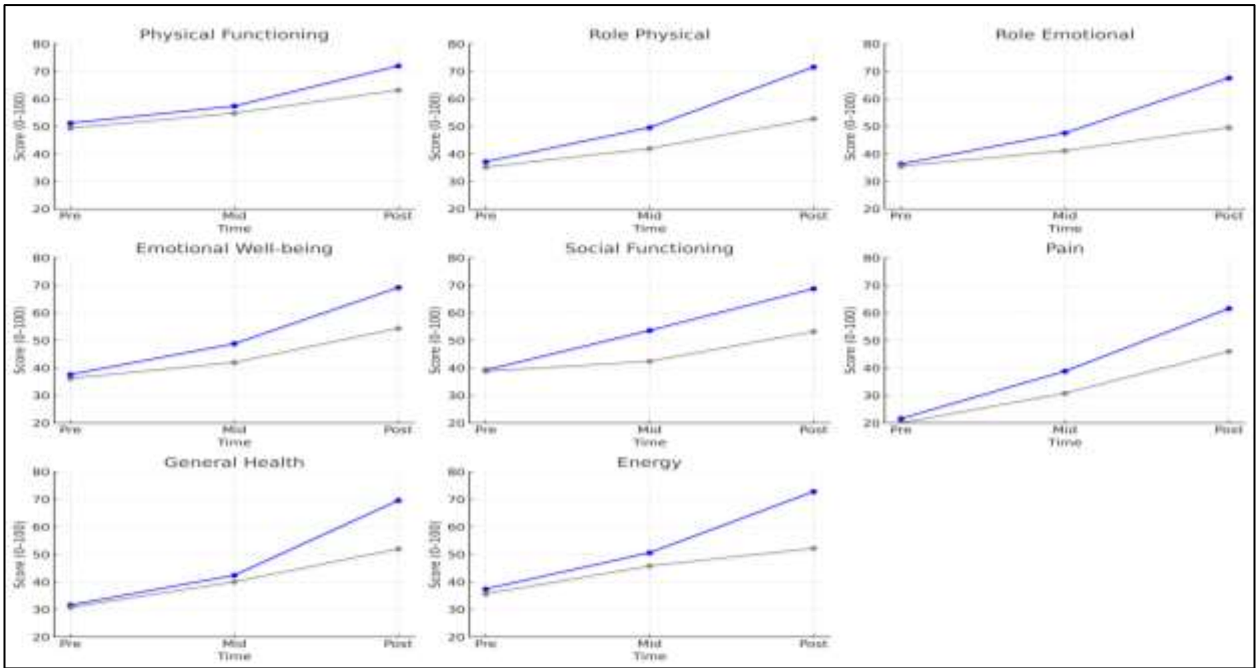

Figure-III: Comparative trajectories of SF-36 domains

REFERENCES

1. Bhutto M, Shadmehr A, Hadian MR, Talebian S, Rana Z, Asad SA. Test-retests reliability of digital photography in measuring quadriceps-angle and pelvic tilt angle in healthy population. Pak J Med Health Sci. 2021;15:3365-3367.
2. Chen Z, Wu J, Wang X, Wu J, Ren Z. The Effects of Myofascial Release Technique for Patients with Low Back Pain: A Systematic Review and Meta-analysis. Complement Ther Med. 2021;59:102737. doi: 10.1016/j.ctim.2021.102737.
3. Childs JD, Piva SR, Fritz JM. Responsiveness of the numeric pain rating scale in patients with low back pain. Spine (Phila Pa 1976). 2005;30(11):1331-1334. doi: 10.1097/01.brs.0000164099.92112.29.
4. GBD 2021 Low Back Pain Collaborators. Global, regional, and national burden of low back pain, 1990-2020, its attributable risk factors, and projections to 2050: a systematic analysis of the Global Burden of Disease Study 2021. Lancet Rheumatol. 2023;5(6):e316-e329. doi: 10.1016/S2665-9913(23)00098-X.
5. González-de-la-Flor Á, Cotteret C, García-Pérez-de-Sevilla G, Domínguez-Balmaseda D, Del-Blanco-Muñiz JÁ. Comparison of two different stretching strategies to improve hip extension mobility in healthy and active adults: a crossover clinical trial. BMC Musculoskelet Disord. 2024;25(1):853. doi: 10.1186/s12891-024-07988-9.
6. Gordon R, Bloxham S. A systematic review of the effects of exercise and physical activity on non-specific chronic low back pain. J Clin Diagn Res. 2016;10(4):YE01-YE07.
7. Hains G. Locating and treating low back pain of myofascial origin by ischemic compression. J Can Chiropr Assoc. 2002;46(4):257.
8. Hayden JA, Ellis J, Ogilvie R, Malmivaara A, van Tulder MW. Exercise therapy for chronic low back pain. Cochrane Database Syst Rev. 2021;2021(9):CD009790.
9. Kim WD, Shin D. Effects of Pelvic-Tilt Imbalance on Disability, Muscle Performance, and Range of Motion in Office Workers with Non-Specific Low-Back Pain. Healthcare. 2023;11(6):893. doi: 10.3390/healthcare11060893.
10. Lin HL, Lee WY, Chiang WY, et al. Bodily pain and vitality are the key factors in the disability of chronic low back pain patients under Short Form 36 base study: a five-year cohort study. Health Qual Life Outcomes. 2024;22:88. doi: 10.1186/s12955-024-02302-6
11. LoMartire R, Äng BO, Gerdle B, Vixner L. Psychometric properties of Short Form-36 Health Survey, EuroQol 5-dimensions, and Hospital Anxiety and Depression Scale in patients with chronic pain. Pain. 2020;161(1):83-95. doi: 10.1097/j.pain.0000000000001700.
12. Narenthiran P, Smith IG, Williams FM. Does the Addition of Manual Therapy to Exercise Therapy Improve Pain and Disability Outcomes in Chronic Low Back Pain: A Systematic Review. J Bodyw Mov Ther. 2025;42:146-152. doi: 10.1016/j.jbmt.2024.12.004.

13. Nugent SM, Lovejoy TI, Shull S, Dobscha SK, Morasco BJ. Associations of Pain Numeric Rating Scale Scores Collected during Usual Care with Research Administered Patient Reported Pain Outcomes. Pain Med. 2021;22(10):2235-2241. doi: 10.1093/pm/pnab110.
14. Preece SJ, Tan YF, Alghamdi TDA, Arnall FA. Comparison of Pelvic Tilt Before and After Hip Flexor Stretching in Healthy Adults. J Manipulative Physiol Ther. 2021;44(4):289-294. doi: 10.1016/j.jmpt.2020.09.006.
15. Qaseem A, Wilt TJ, McLean RM, Forciea MA, Denberg TD, Barry MJ, et al. Noninvasive Treatments for Acute, Subacute, and Chronic Low Back Pain: A Clinical Practice Guideline From the American College of Physicians. Ann Intern Med. 2017;166(7):514-530. doi: 10.7326/M16-2367.
16. Shah SG, Kage V. Effect of Seven Sessions of Posterior-to-Anterior Spinal Mobilisation versus Prone Press-ups in Non-Specific Low Back Pain - Randomized Clinical Trial. J Clin Diagn Res. 2016;10(3):YC10-YC13. doi: 10.7860/JCDR/2016/15898.7485.
17. Shamsi MB, Shahsavari S, Safari A, Mirzaei M. A Randomized Clinical Trial for the Effect of Static Stretching and Strengthening Exercise on Pelvic Tilt Angle in LBP Patients. J Bodyw Mov Ther. 2020;24(3):15-20. doi: 10.1016/j.jbmt.2020.02.001.
18. Shnayderman I, Katz-Leurer M. An aerobic walking programme versus muscle-strengthening programme for chronic low back pain: a randomized controlled trial. Clin Rehabil. 2013;27(3):207-214.
19. Shum GL, Tsung BY, Lee RY. The Immediate Effect of Posteroanterior Mobilization on Reducing Back Pain and the Stiffness of the Lumbar Spine. Arch Phys Med Rehabil. 2013;94(4):673-679. doi: 10.1016/j.apmr.2012.11.020.
20. Sugavanam T, Sannasi R, Anand PA, Ashwin Javia P. Postural asymmetry in low back pain - a systematic review and meta-analysis of observational studies. Disabil Rehabil. 2025;47(7):1659-1676. doi: 10.1080/09638288.2024.2385070.
21. Suits WH. Clinical Measures of Pelvic Tilt in Physical Therapy. Int J Sports Phys Ther. 2021;16(5):1366-1375.
22. Tsagkaris C, Papazoglou AS, Eleftheriades A, Tsakopoulos S, Alexiou A, Găman MA, et al. Infrared Radiation in the Management of Musculoskeletal Conditions and Chronic Pain: A Systematic Review. Eur J Investig Health Psychol Educ. 2022;12(3):334-343. doi: 10.3390/ejihpe12030024.
23. Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care. 1992;30(6):473-483.
24. World Health Organization. WHO guideline for non-surgical management of chronic primary low back pain in adults in primary and community care settings. Geneva: World Health Organization; 2023. Licence: CC BY-NC-SA 3.0 IGO.
25. Wu Z, Wang Y, Ye X, Chen Z, Zhou R, Ye Z, Huang J, Zhu Y, Chen G, Xu X. Myofascial Release for Chronic Low Back Pain: A Systematic Review and Meta-Analysis. Front Med. 2021;8:697986. doi: 10.3389/fmed.2021.697986.
26. Xu A, Huang Q, Rong J, Wu X, Deng M, Ji L. Effectiveness of ischemic compression on myofascial trigger points in relieving neck pain: A systematic review and meta-analysis. J Back Musculoskelet Rehabil. 2023;36(4):783-798. doi:10.3233/BMR-220045