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Comparison Between the Effectiveness of Core Strengthening Exercises and William Flexion Exercises for Treatment of Non-Specific Low Back Pain in Elderly Individuals

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ABSTRACT

Background: Non-specific low back pain (NSLBP) is highly prevalent among elderly individuals and substantially impairs mobility and independence. Exercise-based rehabilitation is a cornerstone of conservative management, yet comparative evidence between commonly used exercise strategies remains limited in older adults. Objective: To compare the effectiveness of core strengthening exercises (CSE) versus William flexion exercises (WFE) in reducing pain, improving disability, and enhancing trunk muscle strength among elderly individuals with NSLBP. Methods: A randomized controlled trial was conducted among 60 participants aged 60–80 years with NSLBP, allocated to CSE (n=30) or WFE (n=30). Both groups received supervised sessions three times weekly for eight weeks. Outcomes included pain intensity (VAS), functional disability (ODI), and trunk flexor/extensor strength measured using dynamometry at baseline, Week 4, and Week 8. Results: Both groups improved significantly over time. At Week 8, CSE demonstrated superior outcomes compared with WFE for pain (mean difference −0.70, 95% CI −1.19 to −0.21; p=0.006), disability (mean difference −6.70, 95% CI −9.31 to −4.09; p<0.001), flexor strength (mean difference 4.80 Nm, 95% CI 1.16 to 8.44; p=0.011), and extensor strength (mean difference 7.70 Nm, 95% CI 3.85 to 11.55; p<0.001). Conclusion: Both exercise programs improved outcomes in elderly NSLBP, but core strengthening produced greater disability reduction and trunk strength gains by Week 8.

Keywords
Non-specific low back pain, elderly, core strengthening, William flexion, disability, trunk strength.

INTRODUCTION

Non-specific low back pain (NSLBP) is commonly defined as pain localized between the inferior margin of the ribs and the gluteal folds, without a clearly identifiable specific pathology such as fracture, infection, tumor, or radiculopathy (1). Among elderly individuals, NSLBP represents a major cause of restricted mobility, functional dependence, and reduced quality of life, with age-related contributors including degenerative spinal changes, sarcopenia, diminished trunk muscle endurance, altered postural alignment, and impaired neuromuscular control (2). These factors collectively increase vulnerability to persistent pain and disability, and they may also reduce the capacity of older adults to tolerate or benefit from generic exercise prescriptions, thereby creating a need for targeted rehabilitation strategies that address both symptoms and underlying functional impairments (3).

Exercise-based physiotherapy remains a cornerstone of conservative NSLBP management, with evidence supporting its role in reducing pain and improving disability and physical function across diverse patient populations (4). However, the optimal exercise strategy for older adults remains debated because aging is associated with reductions in trunk extensor strength and lumbopelvic stability, both of which are closely linked to balance, gait efficiency, and maintenance of upright posture during activities of daily living (2,3). Core strengthening exercises (CSE) aim to enhance activation and endurance of deep stabilizing musculature and improve spinal segmental control, which may reduce mechanical stress and improve functional performance; systematic and clinical evidence has supported the effectiveness of core stability programs in patients with NSLBP (5,8). In contrast, William flexion exercises (WFE) emphasize lumbar flexion-based movements and strengthening of abdominal and hip musculature, with the clinical rationale of reducing lumbar lordosis and potentially decreasing facet loading and discomfort in individuals who demonstrate flexion preference or extension intolerance (4,7). WFE are frequently used in older adults because they can be well tolerated and may provide symptom relief through improved flexibility and reduced spinal compressive loading patterns (6,7).

Despite the widespread clinical use of both approaches, direct head-to-head evidence comparing CSE and WFE in elderly individuals—particularly using multidimensional outcomes that include both patient-reported disability and objective trunk muscle performance—remains limited (9). Given that trunk extensor strength is critical for postural control and functional independence in older populations, establishing which exercise strategy provides superior improvements in disability and trunk performance could strengthen rehabilitation decision-making and improve individualized treatment selection (3,9). Therefore, this randomized controlled trial compared the effectiveness of CSE versus WFE in elderly participants with NSLBP over an 8-week supervised program, evaluating pain intensity, functional disability, and trunk flexor/extensor strength. It was hypothesized that CSE would produce greater improvements in disability and trunk muscle performance than WFE due to enhanced lumbopelvic stabilization and neuromuscular control (5,8).

MATERIALS AND METHODS

This prospective randomized controlled trial was conducted at a university-affiliated physiotherapy clinic to compare two structured therapeutic exercise programs for elderly individuals with NSLBP. Ethical approval was obtained from the institutional review board, and all participants provided written informed consent prior to enrollment. Participants aged 60–80 years with NSLBP of at least six weeks' duration were recruited through outpatient physiotherapy referrals and clinic-based screening. NSLBP was operationally defined as pain located between the costal margin and the gluteal folds in the absence of identifiable specific spinal pathology, consistent with accepted clinical definitions (10). Individuals were excluded if they had a history of spinal surgery, signs of radiculopathy, suspected infection or tumor, inflammatory joint disease, uncontrolled cardiovascular or neurological disease, or cognitive impairment that could interfere with safe participation and valid outcome assessment (10).

After baseline assessment, eligible participants (n=60) were randomly assigned in a 1:1 ratio into a Core Strengthening Exercise group (CSE, n=30) or a William Flexion Exercise group (WFE, n=30). Randomization was performed using computer-generated random numbers, and outcome assessments were performed by an assessor who was not involved in treatment delivery. Both interventions were delivered as supervised sessions three times per week over eight weeks, with each session lasting approximately 45 minutes and consisting of warm-up activities, protocol-specific exercise training, and cool-down components. Exercise intensity and progression were individualized according to participant tolerance, symptom response, and ability to maintain correct movement quality, consistent with exercise-based rehabilitation principles recommended for chronic and non-specific low back pain (9).

The CSE program emphasized activation and strengthening of the trunk stabilizing musculature through progressive exercises including transverse abdominis activation using the abdominal drawing-in maneuver, modified planks, bridges with abdominal bracing, side planks, and the bird-dog exercise. The WFE program emphasized lumbar flexion-based movements and hip mobility with pelvic tilts, knee-to-chest stretching, supine single-knee hugs, hip flexor stretching, and flexion-progressive movements. Participant adherence was monitored using attendance logs maintained by treating therapists, and any adverse symptoms reported during sessions were documented as part of routine clinical monitoring procedures.

Outcome measures were assessed at baseline, 4 weeks, and 8 weeks. Pain intensity was measured using a 10-cm Visual Analog Scale (VAS), and functional disability was assessed using the Oswestry Disability Index (ODI), both widely used and validated tools for NSLBP clinical trials (10). Trunk flexor and extensor strength were assessed using handheld dynamometry, with peak force outputs recorded as the primary strength metric for each muscle group. For consistency, the same assessor conducted strength testing across all time points using standardized verbal instructions and consistent positioning.

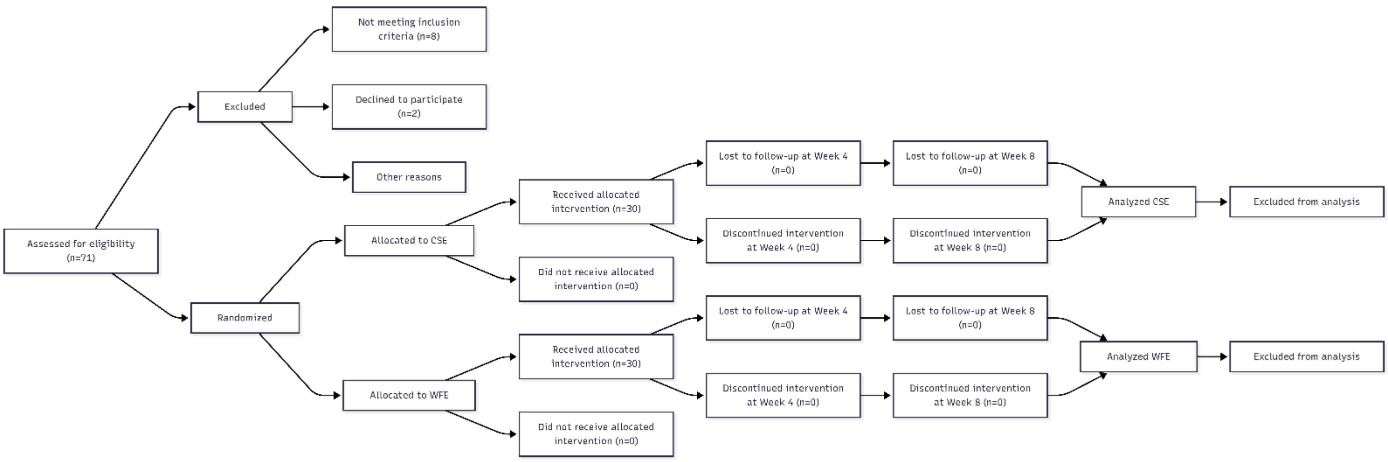

Figure 1 Consort Flowchart

Statistical analyses were conducted to evaluate within-group change over time and between-group differences at each follow-up. Repeated measures analysis of variance was the primary analytic approach for time effects and group-by-time interaction, with statistical significance defined at $p<0.05$. In addition, between-group mean differences (CSE−WFE) with 95% confidence intervals were calculated at each time point for primary and secondary outcomes to improve clinical interpretability. Effect sizes were expressed using standardized mean differences for Week 8 group comparisons to quantify the magnitude of treatment effect (9,10).

RESULTS

At baseline, pain severity was comparable between groups (VAS: 6.9±1.2 vs 7.0±1.3; p=0.758). By Week 4, both groups improved, and the between-group difference remained non-significant (mean difference −0.30, 95% CI −0.84 to 0.24; p=0.274). By Week 8, the CSE group demonstrated significantly lower pain than the WFE group (3.1±0.9 vs 3.8±1.0), with a mean difference of −0.70 points (95% CI −1.19 to −0.21; p=0.006), indicating a clinically favorable sustained pain response in the core strengthening regimen.

Table 1. Pain Intensity (VAS) With Between-Group Inference (n=30 per group)

Time Point	CSE Mean ± SD	WFE Mean ± SD	Mean Difference (CSE−WFE)	95% CI	p-value
Baseline	6.9 ± 1.2	7.0 ± 1.3	−0.10	−0.75 to 0.55	0.758
Week 4	4.2 ± 1.1	4.5 ± 1.0	−0.30	−0.84 to 0.24	0.274
Week 8	3.1 ± 0.9	3.8 ± 1.0	−0.70	−1.19 to −0.21	0.006

Negative mean differences favor CSE (lower pain).

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Table 2. Functional Disability (ODI) With Between-Group Inference (n=30 per group)

Time Point	CSE Mean ± SD	WFE Mean ± SD	Mean Difference (CSE−WFE)	95% CI	p-value
Baseline	42.5 ± 6.3	43.0 ± 6.0	−0.50	−3.68 to 2.68	0.754
Week 4	30.4 ± 5.5	33.9 ± 5.7	−3.50	−6.39 to −0.61	0.019
Week 8	22.1 ± 4.9	28.8 ± 5.2	−6.70	−9.31 to −4.09	<0.001

Negative mean differences favor CSE (lower disability).

Table 3. Trunk Muscle Strength at Baseline and Week 8 With Between-Group Inference (n=30 per group)

Measure	Time Point	CSE Mean ± SD	WFE Mean ± SD	Mean Difference (CSE−WFE)	95% CI	p-value
Flexor Strength (Nm)	Baseline	45.2 ± 6.7	44.7 ± 7.0	0.50	−3.04 to 4.04	0.778
Flexor Strength (Nm)	Week 8	53.8 ± 7.3	49.0 ± 6.8	4.80	1.16 to 8.44	0.011
Extensor Strength (Nm)	Baseline	47.9 ± 7.1	48.2 ± 7.4	−0.30	−4.05 to 3.45	0.873
Extensor Strength (Nm)	Week 8	59.4 ± 7.8	51.7 ± 7.1	7.70	3.85 to 11.55	<0.001

Functional disability also demonstrated baseline equivalence (ODI: 42.5±6.3 vs 43.0±6.0; p=0.754). At Week 4, disability reduction favored CSE with a statistically significant mean difference of −3.50 points (95% CI −6.39 to −0.61; p=0.019). By Week 8, the advantage of CSE widened substantially, with ODI scores of 22.1±4.9 versus 28.8±5.2 in WFE, yielding a mean difference of −6.70 points (95% CI −9.31 to −4.09; p<0.001), indicating superior functional recovery in the core strengthening group.

Positive mean differences favor CSE (greater strength).

Objective trunk performance outcomes supported these findings. Flexor strength improved by Week 8 with significantly higher values in the CSE group (53.8±7.3 vs 49.0±6.8; mean difference 4.80 Nm, 95% CI 1.16 to 8.44; p=0.011). Extensor strength demonstrated the largest between-group separation at Week 8, with CSE achieving 59.4±7.8 compared with 51.7±7.1 in WFE (mean difference 7.70 Nm, 95% CI 3.85 to 11.55; p<0.001), reinforcing that core strengthening preferentially improved posterior chain capacity relevant to upright posture and functional independence.

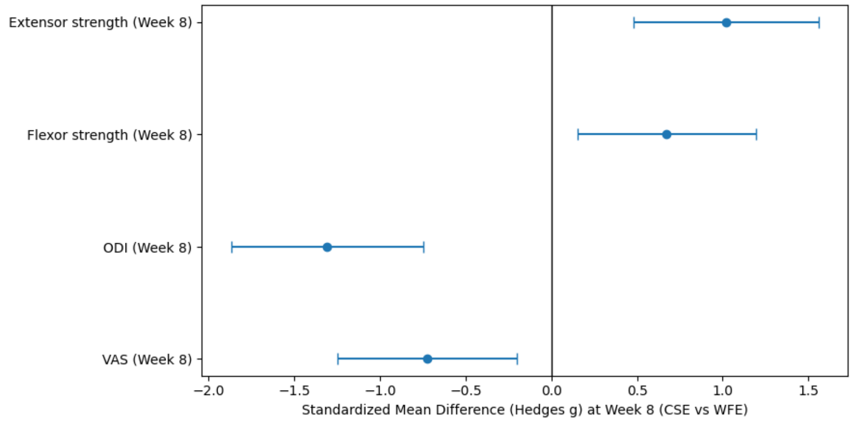

Figure 2 Week 8 Effect Gradient of Core Strengthening vs William Flexion Across Outcomes.

Forest plot showing standardized mean differences (Hedges g) with 95% confidence intervals for Week 8 outcomes comparing Core Strengthening Exercises (CSE) versus William Flexion Exercises (WFE). Negative values indicate better outcomes for CSE for pain (VAS) and disability (ODI), while positive values indicate greater strength gains in CSE for trunk flexors and extensors. The vertical reference line at 0 represents no between-group difference. At Week 8, core strengthening demonstrated a consistent advantage over William flexion across all domains. The largest between-group effect was observed for disability (ODI), followed by pain reduction (VAS), indicating stronger functional recovery and sustained symptom improvement with CSE. Objective performance outcomes also favored CSE, with notably greater improvements in trunk extensor strength and moderate gains in trunk flexor strength, supporting the clinical value of stabilization-focused training for enhancing postural and functional capacity in elderly individuals with NSLBP.

DISCUSSION

This randomized controlled trial demonstrated that both core strengthening exercises and William flexion exercises produced meaningful improvements in pain and disability over an eight-week supervised program among elderly individuals with NSLBP. However, core strengthening produced superior outcomes by Week 8, particularly for functional disability and trunk extensor strength. These findings align with evidence supporting exercise therapy as a key conservative intervention for NSLBP in older adults and highlight the clinical importance of targeting spinal stability and trunk muscle performance to optimize functional recovery (9).

Pain reduction occurred in both groups, which is consistent with prior work indicating that structured exercise—whether stabilization-oriented or mobility-oriented—can reduce symptom intensity through improved movement confidence, muscle conditioning, and reduced mechanical sensitivity (5,7). Nevertheless, the observed Week 8 advantage favoring core strengthening suggests that interventions emphasizing trunk stabilization may confer more sustained symptom benefits compared with flexion-dominant approaches. This interpretation is supported by evidence that core stability training improves neuromuscular control and may reduce excessive intersegmental movement that perpetuates mechanical pain responses in NSLBP (5,8).

The most clinically notable between-group difference in this trial was the superior improvement in functional disability as measured by ODI. By Week 8, the core strengthening group exhibited a 6.7-point lower ODI score than the William flexion group, with confidence intervals indicating a robust and clinically interpretable separation. Functional recovery in elderly NSLBP is strongly influenced by the ability to maintain upright posture, stabilize the trunk during transitional movements, and sustain endurance during daily activities—capacities that are closely linked to extensor strength and deep stabilizer coordination (2,3). In this context, core strengthening likely improved the integration of abdominal bracing and posterior chain activation during functional tasks, contributing to superior disability reduction compared with flexion-dominant programming. Objective trunk strength outcomes reinforced the functional findings, particularly the greater extensor strength improvements achieved with core strengthening. Extensor weakness is a common age-related impairment and is associated with postural kyphosis, gait inefficiency, and increased functional dependence, making extensor strength a highly relevant mechanistic target in elderly rehabilitation (2,3). Systematic evidence has suggested that core stability interventions can produce superior improvements in function and performance compared with generalized or flexibility-based programs in NSLBP, which is consistent with the present results (8). William flexion exercises remain clinically valuable, particularly when flexion preference is present or when stabilization exercises are initially poorly tolerated due to pain; evidence indicates that William flexion can reduce pain intensity in elderly low back pain populations, supporting the improvements observed in the comparator group (6,7). However, flexion-dominant approaches may not provide sufficient loading stimulus for posterior chain strengthening, which may limit improvements in trunk extensor capacity and, consequently, longer-term functional performance.

This study contributes clinically relevant comparative evidence by demonstrating that while both regimens improved pain, core strengthening produced superior disability and extensor strength gains by Week 8, outcomes that are highly relevant to independence in older adults. The findings support an approach in which flexion-based exercises may be used initially for symptom modulation in selected patients, followed by progressive integration of stabilization and extensor strengthening once pain is controlled and movement tolerance improves. Such progression is consistent with broader evidence on exercise-based management in older adults with NSLBP (9).

Several limitations should be acknowledged. The follow-up duration was limited to eight weeks, preventing evaluation of long-term recurrence, maintenance of strength gains, or sustained disability reduction. In addition, although trunk strength was measured objectively, detailed reliability parameters for dynamometry were not reported in the present manuscript and should be standardized in future work. Larger multicenter trials with longer follow-up and additional outcomes such as balance, fall risk, and quality of life would strengthen the evidence base for optimizing NSLBP rehabilitation strategies in elderly populations (3,9).

CONCLUSION

Both core strengthening exercises and William flexion exercises significantly improved pain and disability in elderly individuals with non-specific low back pain over an eight-week supervised program; however, core strengthening produced superior functional disability reduction and greater improvements in trunk extensor strength by Week 8, indicating that stabilization-focused rehabilitation may provide enhanced functional recovery and objective trunk performance benefits in this population.

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