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Core Stability Exercise Intervention for Managing Pain and Flexibility in Nurses with Non-Specific Low Back Pain

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Abstract:
Low Back Pain (LBP) affected 619 million people globally in 2020, and the number is projected to increase to 843 million by 2050. Among nurses, the prevalence of LBP reaches 72%, with significant risk factors including long working hours, poor posture, and heavy workloads. This condition negatively impacts nurses' well-being, productivity, and the quality of healthcare services. Physiotherapy interventions, particularly core stability exercises, have been proposed as a practical approach to reduce pain and improve functional mobility. This study aimed to examine the effect of core stability exercise on pain intensity and flexibility in nurses with non-specific LBP. A proper experimental study with a pre–post test control group design was conducted. A total of 47 nurses who met the inclusion criteria were recruited using simple random sampling. Pain intensity and flexibility were measured before and after the intervention. Data were analyzed using the paired sample t-test. Core stability exercise significantly reduced pain intensity ($p = 0.000$, <0.05) and significantly improved flexibility ($p = 0.000$, <0.05). These findings indicate that the intervention positively impacted musculoskeletal health among nurses with non-specific LBP. Core stability exercise is an effective intervention for reducing pain and enhancing flexibility in nurses with non-specific LBP. Activating core muscles through exercise promotes vasodilation, improves blood circulation, and increases oxygen and nutrient delivery to myofascial tissue, producing analgesic effects. In addition, coordinated muscle contractions enhance lumbar stability, reduce intervertebral disc pressure, and minimize muscle tension, improving functional flexibility.

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INTRODUCTION

Low Back Pain (LBP) is pain or discomfort localized in the lumbar region of the spine. It can be categorized into specific and non-specific types. Specific LBP is associated with identifiable pathologies or structural abnormalities of the spine, often accompanied by radicular symptoms or other spinal-related manifestations (Chiarotto et al., 2022). Conversely, non-specific LBP, which constitutes most cases, occurs when no definitive pathological cause can be identified (Malik et al., 2022). Patients with non-specific LBP often present with muscular tension, restricted range of motion, and pain that may or may not radiate to the lower extremities (Shashi, P., & Atul, S., 2024). This condition is closely related to muscle flexibility, particularly in the lumbar, pelvic, and hamstring regions. Reduced flexibility leads to limited mobility and increases the risk of injury, further exacerbating the pain (Behm et al., 2021).

The burden of LBP is globally significant. According to the World Health Organization (WHO, 2023), approximately 619 million people were affected by LBP in 2020, and this number is projected

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to rise to 843 million by 2050 due to population growth and aging. Importantly, non-specific LBP accounts for nearly 90% of all LBP cases worldwide. This condition is also more prevalent among women and is one of the leading causes of disability, reduced productivity, and increased healthcare utilization. Beyond its impact on patients' physical health, LBP imposes substantial economic and occupational burdens.

Nurses represent one of the occupational groups at particularly high risk for LBP. Due to the physical demands of nursing—such as lifting and transferring patients, prolonged standing, and frequent bending or twisting—the prevalence of LBP in this population is remarkably high. Research in Slovenia reported a prevalence as high as 85.9% (Pleho et al., 2021). Similar findings have been documented in Indonesia, with prevalence rates ranging from 31.8% to 65% depending on the clinical setting (Situmeang et al., 2023). Such high prevalence rates highlight the urgent need for preventive and therapeutic interventions targeting occupational health among nurses.

In the context of Indonesia, LBP among nurses is not only common but also significantly affects healthcare delivery. Observations at Prof. Dr. H. Aloei Saboe Regional General Hospital in Gorontalo indicated that nurses frequently engage in tasks requiring heavy physical exertion, including lifting patients and adopting awkward postures, which increases their susceptibility to LBP. With a Bed Occupancy Rate (BOR) of 84.6% in the first half of 2024, nurses' workload is disproportionately high relative to staffing levels, further amplifying the risk of musculoskeletal disorders. Data from the hospital's physiotherapy clinic recorded 105 nurse visits between 2023 and June 2024 for non-specific LBP, with initial pain scores ranging between 6 and 8 on the Numeric Rating Scale and flexibility scores below 7.5 inches on the Sit and Reach test. These findings underscore the clinical relevance and urgency of addressing LBP in this occupational group.

A wide range of therapeutic interventions has been proposed for non-specific LBP, including infrared therapy, shortwave diathermy, transcutaneous electrical nerve stimulation (TENS), and stretching exercises (Ozen et al., 2023). Hospitals also employ preventive measures through ergonomic training to promote proper posture during patient handling. However, despite these interventions, many nurses continue to experience LBP due to the repetitive and physically demanding nature of their work, combined with multifactorial risk factors including age, gender, obesity, smoking, psychosocial stress, and poor job satisfaction (Alammari et al., 2025). These limitations highlight the need for complementary and evidence-based exercise interventions targeting the underlying pathophysiological mechanisms of LBP.

Core stability exercise has emerged as a promising intervention for managing non-specific LBP (Smrcina et al., 2022). This exercise program focuses on strengthening the core muscles, including the diaphragm, transversus abdominis, multifidus, and pelvic floor muscles, thereby improving spinal stability, reducing intervertebral disc pressure, and enhancing flexibility. Physiologically, core stability exercise promotes vasodilation, increasing blood circulation and oxygen delivery to myofascial tissues, alleviating muscle spasms, and reducing pain (Islam et al., 2023; Lestari et al., 2021). Furthermore, coordinated contractions of the core muscles improve postural control and lumbar stability, thereby preventing recurrence and supporting functional recovery. Several studies have demonstrated the effectiveness of core stability exercise in reducing pain intensity and improving mobility in patients with non-specific LBP (Frizziero et al., 2021; Hlang et al., 2021).

Despite the growing evidence supporting core stability exercise, research focusing on its impact among nurses—a group disproportionately affected by LBP—remains limited, particularly in Indonesia. Given the high prevalence of LBP among nurses in Prof. Dr. H. Aloei Saboe Hospital, coupled with the substantial burden on healthcare delivery, there is a pressing need for targeted interventions. This study aims to fill this gap by evaluating the effect of core stability exercise on pain

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intensity and flexibility in nurses with non-specific LBP in inpatient care settings. The findings are expected to contribute valuable evidence to inform physiotherapy practices and workplace health promotion strategies in Indonesia and beyond, addressing both clinical outcomes and occupational health implications.

METHOD

This study employed a proper experimental design with a pre–post-test control group approach, which was considered the most appropriate method to determine the causal relationship between core stability exercise and its effects on pain intensity and flexibility in nurses with non-specific low back pain (LBP). The design enabled the comparison of intervention and control groups by measuring outcomes before and after the intervention.

The population in this study consisted of fifty nurses working in the inpatient unit of Prof. Dr. H. Aloei Saboe Regional General Hospital, Gorontalo, who had been clinically diagnosed with non-specific LBP. Participants were required to meet specific inclusion criteria, such as being within the age range of twenty-five to fifty-five years, currently experiencing LBP, willing to provide informed consent, and not undergoing other therapeutic programs during the study period. Individuals with spinal deformities, neurological disorders, or systemic diseases were excluded from participation. The minimum required sample size was calculated using Slovin's formula with a 5% margin of error, yielding 44 participants. An additional five percent was included to reduce the possibility of data loss due to dropouts, resulting in a final sample size of forty-seven. Participants were then randomly assigned to either an intervention or a control group to ensure comparability.

The instruments used in this study were standardized and validated tools for assessing the dependent variables. Pain intensity was measured using the Numeric Rating Scale (NRS), which ranges from zero, indicating no pain, to ten, representing the worst pain imaginable. Flexibility of the lumbar and hamstring muscles was assessed through the Sit and Reach Test, a widely used measure of musculoskeletal flexibility. The Pain and Distress Scale (PDS) was also employed to capture complementary information regarding pain-related discomfort.

The independent variable of this research was the administration of core stability exercises. The program included movements such as pelvic tilt, bridging, bird-dog, and side plank, which were selected because they emphasized activating and strengthening the muscles that stabilize the trunk and lower back. These exercises were conducted under the supervision of a physiotherapist, three times a week, for three weeks, resulting in a total of nine exercise sessions. Each session lasted approximately thirty to forty minutes. The dependent variables consisted of pain intensity, measured using the NRS, and flexibility, measured using the Sit and Reach Test. Pain was categorized into five levels: no pain, mild, moderate, severe, and very severe. Flexibility was classified as poor, fair, good, or excellent, depending on the achieved scores.

The procedure of this study began with the identification and recruitment of participants who met the inclusion criteria. Before the intervention was conducted, baseline measurements were obtained through a pre-test assessment of pain intensity and flexibility. The intervention group subsequently received the planned core stability exercise program, while the control group continued their routine activities without additional treatment. After three weeks of intervention, a post-test was carried out using the same instruments to evaluate changes in pain and flexibility in both groups.

All collected data were processed systematically. Questionnaires and physical performance test results were edited to ensure completeness and accuracy before being coded into numerical form and entered into data sheets. The data were then tabulated and analyzed using SPSS software. Descriptive statistics were employed to present the participants' general characteristics and describe

baseline conditions. To test the hypotheses, paired t-tests were used to determine the differences between pre-test and post-test results within each group. In contrast, independent t-tests were applied to assess differences between the intervention and control groups. A significance level of less than 0.05 was set to determine statistical significance.

The study was conducted at the Physiotherapy Clinic of Prof. Dr. H. Aloei Saboe Regional General Hospital in Gorontalo, with the research implementation spanning three weeks. All stages, from recruitment to data collection and intervention, were performed within this timeframe.

RESULT

Forty-seven respondents, predominantly female nurses (91.5%), participated in this study, while male participants accounted for only 8.5%. Most respondents fell within the 41–45 years age group (25.5%), followed by the 31–35 years age group (21.3%), while the smallest proportion was observed in the 25–30 years age group (10.6%). Regarding work experience, most respondents worked for 11–20 years (46.81%), while the fewest worked between 1–10 years (25.53%). These findings are presented in Table 1.

Table 1. Distribution of Respondents' Characteristics (n = 47)

Characteristics	Category	n	%
Gender	Male	4	8.5
	Female	43	91.5
Age (years)	25–30	5	10.6
	31–35	10	21.3
	36–40	6	12.8
	41–45	12	25.5
	46–50	6	12.8
	51–55	8	17.0
Length of service	1–10 years	12	25.53
	11–20 years	22	46.81
	21–30 years	13	27.66

Pain intensity, measured using the Numeric Rating Scale (NRS), showed a marked reduction after the intervention. Before the core stability exercise program, the mean pain score was 5.32 ± 1.81, with a minimum score of 2 and a maximum of 9. After the intervention, the mean pain score decreased substantially to 1.21 ± 0.98, with a range of 0 to 4. This demonstrates a significant decline in pain perception among respondents. The descriptive statistics of NRS are summarized in Table 2.

Table 2. Pain Intensity (NRS) Before and After Core Stability Exercise (n = 47)

Variable	N	Min	Max	Mean	Std. Dev
Pre-test	47	2.0	9.0	5.32	1.81
Post-test	47	0.0	4.0	1.21	0.98

Flexibility levels, as assessed by the Sit and Reach Test, also showed significant improvement. The mean flexibility score before the intervention was 11.61 ± 4.54 cm, with values ranging from 3.5 to 19 cm. After the intervention, the mean flexibility score increased to 17.89 ± 3.32 cm, with a range of 8 to 25 cm. The improvement highlights the positive impact of core stability exercise on musculoskeletal function. The data are shown in Table 3.

Table 3. Flexibility Scores (Sit and Reach Test) Before and After Core Stability Exercise (n = 47)

Variable	N	Min	Max	Mean	Std. Dev
Pre-test	47	3.50	19.0	11.61	4.54
Post-test	47	8.00	25.0	17.89	3.32

Further categorization of the variables confirmed significant changes in pain intensity and flexibility. Before the intervention, 57.44% of respondents were in the moderate pain category (NRS 4–6), and 25.53% reported severe pain (NRS 7–10). After the intervention, no respondents reported severe pain; 72.34% were categorized as having mild pain (NRS 1–3), and 25.53% reported no pain. For flexibility, 97.87% of respondents scored below 19 cm at baseline, whereas post-intervention, 44.69% had achieved flexibility above 19 cm, demonstrating a clear functional improvement (Table 4).

Table 4. Distribution of Pain Intensity and Flexibility Categories Before and After Intervention (n = 47)

Variable	Category	n	%
Pre-test Pain	No pain (0)	0	0.0
	Mild (1–3)	8	17.02
	Moderate (4–6)	27	57.44
	Severe (7–10)	12	25.53
Post-test Pain	No pain (0)	12	25.53
	Mild (1–3)	34	72.34
	Moderate (4–6)	1	2.13
	Severe (7–10)	0	0.0
Pre-test Flex.	>19 cm	1	2.13
	<19 cm	46	97.87
Post-test Flex.	>19 cm	21	44.69
	<19 cm	26	55.31

Normality testing using the Shapiro-Wilk test confirmed that all variables (pre- and post-test NRS and flexibility) were normally distributed, with p-values greater than 0.05. Subsequent inferential analysis using paired sample t-tests revealed significant differences between pre- and post-test scores. For pain intensity, the paired t-test showed $p = 0.000$ ($p < 0.05$) with $t = 24.158$, indicating a significant reduction. Similarly, for flexibility, the paired t-test also showed a p-value of 0.000 ($p < 0.05$) with a t-value of -17.828, confirming a significant improvement. These results are presented in Table 5.

Table 5. Paired Sample t-Test Results (n = 47)

Parameter	Group	Mean Difference	t-value	t-table	p-value
Pain (NRS)	Pre–Post	-4.11	24.158	2.013	0.000
Flexibility	Pre–Post	+6.28	-17.828	2.013	0.000

These findings demonstrate that core stability exercises were highly effective in reducing pain intensity and significantly improving flexibility among nurses with non-specific low back pain.

DISCUSSION

Low back pain (LBP) remains one of the most prevalent occupational health problems worldwide. It is particularly concerning among healthcare workers, such as nurses, constantly

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exposed to physical workload and ergonomic stressors. The present study investigated the effect of Core Stability Exercise (CSE) on pain intensity and lumbar flexibility among nurses suffering from non-specific LBP in the inpatient installation of Prof. Dr. H. Aloei Saboe Regional General Hospital, Gorontalo. The findings provide compelling evidence that CSE significantly reduces pain intensity and improves lumbar flexibility, supporting its role as an effective non-pharmacological intervention for managing musculoskeletal complaints in nursing practice.

Before the intervention, the baseline data revealed that most participants experienced moderate to severe pain, with a mean Numeric Rating Scale (NRS) score of 5.32 ± 1.81. These findings are consistent with the existing literature, which reports a high prevalence of musculoskeletal pain among nurses, particularly in the lumbar region, due to repetitive bending, lifting, patient mobilization, and prolonged standing during their shifts. Previous studies by Zaitoon et al. (2024) and Atta et al. (2021) also confirmed that nurses are at heightened risk of developing non-specific LBP, often resulting in reduced work performance and increased absenteeism. This pre-test finding underlines the urgent need for preventive interventions addressing the occupational hazards healthcare workers face.

In addition to high pain levels, the pre-test assessment demonstrated limited lumbar flexibility, with a mean Sit and Reach Test score of 11.61 ± 4.54 cm. Restricted flexibility indicates impaired musculoskeletal function and increases the likelihood of recurrent strain injuries and chronic LBP. Similar findings have been reported in previous research, where healthcare professionals with chronic LBP demonstrated reduced spinal range of motion and impaired postural control (Rezael et al., 2021). The reduced flexibility observed in this study further emphasizes that pain and functional limitation are interrelated in the clinical presentation of non-specific LBP among nurses.

The results substantially improved both outcomes after implementing a structured three-week CSE program. Pain intensity was reduced to a mean of 1.21 ± 0.98, with most respondents reporting either mild or no pain. This significant reduction aligns with earlier studies in which CSE effectively decreased pain levels in individuals with non-specific LBP (Agustin et al., 2023). Similarly, Nilmart et al. (2025) documented a decrease in Visual Analog Scale (VAS) scores from 7.85 to 4.58 following the implementation of CSE. The current findings reinforce the growing evidence suggesting that CSE is a reliable, safe, cost-effective therapeutic strategy for pain management in occupational health settings.

Furthermore, lumbar flexibility showed remarkable improvement, with mean Sit and Reach scores increasing to 17.89 ± 5.12 cm after the intervention. Nearly half of the participants achieved scores above 19 cm, indicating clinically meaningful gains in spinal mobility. Previous research strongly supports this outcome, demonstrating that CSE strengthens the deep core muscles and enhances spinal stability and range of motion (Gorji et al., 2021). The exercises, such as bridging, bird dog, and side plank, promote isometric contractions and activate stabilizing muscles like the transversus abdominis and multifidus. These muscles play a crucial role in maintaining spinal alignment and protecting the lumbar region from excessive strain. By improving flexibility, CSE addresses one of the key functional impairments associated with LBP, thereby reducing the risk of recurrence.

The physiological mechanisms underlying the effectiveness of CSE can be explained from several perspectives. First, CSE improves neuromuscular control and activates deep trunk muscles, which are often inhibited in patients with chronic LBP. This stabilization reduces abnormal loading on the spine and intervertebral discs, diminishing mechanical irritation of pain-sensitive structures. Second, CSE enhances blood circulation and oxygen supply to lumbar tissues, thereby reducing ischemia-induced pain and muscle spasms (Yamaguchi et al., 2023). Third, according to the Gate Control Theory of pain, stimulation of proprioceptors during exercise inhibits nociceptive input at the

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spinal cord level, thereby modulating pain perception (Polonowita et al., 2024). These mechanisms explain why participants experienced significant analgesia and functional improvement following the intervention.

From a clinical perspective, the study's findings have important implications for nursing practice and occupational health management. Non-specific LBP among nurses affects the individual's well-being and impacts patient safety and the quality of care. High absenteeism, reduced concentration, and diminished physical capacity have been documented as consequences of chronic pain among nurses. Therefore, introducing CSE as a preventive and rehabilitative strategy can contribute to improve workforce sustainability, increase productivity, and enhance patient outcomes. Compared to pharmacological interventions such as analgesics, which carry the risk of side effects and dependency, CSE provides a safe, low-cost, and sustainable alternative that can be easily incorporated into daily routines.

Moreover, implementing CSE programs within hospital settings may help reduce healthcare costs by decreasing the incidence and recurrence of LBP. Systematic reviews have consistently highlighted the role of CSE in improving pain, functional outcomes, and quality of life among individuals with LBP (Gorji et al., 2021). By integrating CSE into occupational health policies, hospitals can foster a healthier workforce and ensure continuity of high-quality care delivery.

Despite the promising findings, several limitations of this study should be acknowledged. The sample size was relatively small and limited to a single-center setting, which may affect the generalizability of the results. Additionally, the intervention period was limited to three weeks, and no long-term follow-up was conducted to determine whether the observed improvements are sustainable over time. Future research should include larger, multi-center studies with more extended follow-up periods to assess the long-term efficacy of CSE. It would also be valuable to compare CSE with other therapeutic modalities such as stretching, aerobic exercise, or ergonomic training, to determine the most effective combination of interventions for managing LBP in nurses.

The discussion highlights that CSE significantly reduced pain and improved lumbar flexibility in nurses with non-specific LBP. These findings align with existing literature and underscore the importance of incorporating structured exercise interventions into occupational health programs. While further research is required to strengthen the evidence base, the current study supports the integration of CSE as a standard practice in managing and preventing LBP among healthcare workers.

CONCLUSION

This study confirms that Core Stability Exercise (CSE) significantly reduces pain intensity and improves flexibility in nurses with non-specific low back pain. The findings highlight that activating core muscles through structured exercise provides spinal stability, enhances blood circulation, and supports functional recovery. As a safe, low-cost, and easily applied intervention, CSE has strong potential to be integrated into occupational health programs in hospital settings, promoting nurses' well-being, reducing musculoskeletal complaints, and maintaining productivity. Future studies are needed to examine the long-term benefits and explore the combination of CSE with ergonomic and workplace interventions.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this research. All procedures were conducted independently, and no financial, personal, or professional relationships influenced the study design, data collection, analysis, or interpretation of the results.

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