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ORIGINAL RESEARCH **PAIN MANAGEMENT**

Effects of 8-week core stabilization exercise with vitamin D supplement on pain and functional limitation in adults with chronic non-specific low back pain

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ABSTRACT

Background & objective: Chronic non-specific low back pain (CNSLBP) is a common, disabling condition that affects millions worldwide, often causing functional limitations and a reduced quality of life. This study examines the combined effects of 8 weeks of core stabilization exercises (CSE) and vitamin D supplementation on pain reduction and functional improvement in adults with CNSLBP, and whether combining CSE with vitamin D supplementation results in greater improvements in pain reduction and functional limitations than CSE alone.

Methodology: A randomized controlled trial was conducted on 62 adults aged 25-45 years, diagnosed with CNSLBP. Participants were randomly assigned to two groups: the experimental group received 8 weeks of CSE and vitamin D supplementation, while the control group received only CSE. Pain intensity was measured using the Visual Analog Scale (VAS), and functional limitations were assessed with the Oswestry Disability Index (ODI). Blood tests for 25-Hydroxyvitamin D levels were conducted before and after the intervention.

Results: Significant improvements were observed in the experimental group. VAS pain scores decreased (P = 0.000), ODI scores showed functional improvement (P = 0.002), and vitamin D levels increased significantly (P = 0.000). The combined intervention was more effective than exercises alone.

Conclusion: The combination of core stabilization exercises and vitamin D supplementation significantly reduced pain and improved functionality in chronic non-specific low back pain patients.

Abbreviations: CNSLBP: Chronic non-specific low back pain, CSE: core stabilization exercises, NCID: Normalizing, Comparison, Interpretation, and Discussion technique, ODI: Oswestry Disability Index, VAS: Visual Analog Scale

Keywords: chronic low back pain; core stabilization exercises; vitamin D supplementation; pain reduction; functional improvement; Oswestry Disability Index; visual analog scale

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1. INTRODUCTION

Chronic low back pain (CNSLBP) is one of the leading causes of disability worldwide, creating significant socioeconomic burdens.[1] The persistent nature of chronic non-specific low back pain (CNSLBP) and its influence on functional abilities make it a serious health concern.[2] Exercises for core stabilization are frequently recommended; however, their efficacy varies.[3] Recent research points to a connection between low vitamin D levels and heightened muscular weakness and pain sensitivity, suggesting that taking a vitamin D supplement in addition to core stabilization may have more beneficial effects.[4,5] Research has shown that chronic pain, especially low back pain, often persists beyond 12 weeks and severely impacts quality of life.[6,7] This pain is largely caused by dysfunctions in the musculoskeletal system and often involves weakened core stabilizing muscles.[8,9]

The exercises that are central to core stabilization work to strengthen these deep muscles, thus relieving strain on the lower back and easing pain.[10,11] Though muscle weakness, increased sensitivity to pain, and inflammation have been linked to Vitamin D deficiency, because low vitamin D impacts inflammation and muscle function, core stabilization exercises may be less helpful in people with low vitamin D levels.[12,13] Therefore, combining the two addresses musculoskeletal and biochemical factors that contribute to pain might turn out to be an accompaniment to exercise therapy to manage chronic low back pain.[14,15]

As a student, this study offers the first-hand opportunity to experience how evidence-based care can improve the outcome in chronic LBP by incorporating physical therapy and nutrition intervention.[16] Clinical guidelines for the management of CNSLBP frequently include core stabilization, one of the most evidence-based routine exercises.[17] It shows the importance of treating an affliction holistically, on both biomechanical and nutritional levels, to manage pain and dysfunction.[18,19]

The study provides valuable information on the integration of exercise therapy and nutritional supplementation that may be helpful when selecting treatment programs. The use of these interventions allows therapists to realize their best results from their clientele, reduce pain, and improve overall function.[20] The program emphasizes an individualized and non-invasive treatment protocol, which offers the patient and medical practitioners alike valuable tools to treat chronic low back pain and improve quality of life.[21]

Studies showing that vitamin D insufficiency is associated with increased pain and muscle dysfunction and that core strength enhances spinal stability led to the selection of this combination.[22] The synergistic effect could improve function and pain management. By modifying nociceptor activity, vitamin D lowers neuropathic pain, improves neuromuscular function, and controls inflammatory cytokines.[23] Low levels are linked to heightened perceptions of chronic pain.[24] By improving lumbar segmental control, trunk muscular coordination, and lowering mechanical load on the spine, core stabilization helps people feel less discomfort.[25]

2. METHODOLOGY

This study was designed as a randomized controlled trial, registered under clinicaltrials.gov.uk with the ID NCT06913413. The clinical setting for this research was Shoukat Medicare in Chiniot. Using G*Power version 3.1.9.2, the required sample size was calculated to be 52 participants, ensuring a confidence level of 95% and statistical power of 0.8. To account for an anticipated 20% attrition rate, a total of 62 participants were recruited, maintaining the required sample size despite possible dropouts. Non-probability purposive sampling was the sampling technique, and participants underwent an 8-week intervention, while the total study spanned six months, including recruitment, follow-up, and analysis.

The inclusion criteria included adult participants aged 25-45 years and suffering from non-specific low back pain that persisted for 12 or more weeks. Adults of working age who were most impacted by CNSLBP were included, with baseline pain score ≥ 4 on Visual Analog Scale (VAS), and confirmed low vitamin D level in the serum (<30 ng/mL).[26] This criterion was selected to prevent degenerative spine alterations brought on by aging and to maintain uniformity in the health of muscles and bones. The exclusion criteria included specific back pain etiology, major comorbidities, recent spine surgical interventions, current use of vitamin D supplementation or selected medications, participation in other therapy, and mental state that precluded compliance.

Table 1: Comparative demographic data

Variables	Group CS-D (n = 30)	Group CS-P (n = 30)
Age (years)	32.17 ± 1.085	32.07 ± 1.048
Gender		
• **Male**	16 (53.3%)	8 (26.7%)
• **Female**	14 (46.7%)	22 (73.3%)
BMI (kg/m^2)	23.46 ± .884	23.25 ± .828
Height (m^2)	2.37 ±.669	2.27 ± .691
Weight (kg)	76.23 ± .774	78.20 ± .761

Data presented as mean ± SD or n (%)

Table 2: Between-group comparison of all variables (Mann-Whitney)

Variable	Time	Group CS-D (n = 30)	Group CS-P (n = 30)	P-Value
VAS	Pre	7.53 ± 0.86	4.77 ± 3.22	0.526
	Post	2.40 ± 2.40	7.20 ± 1.21	0.001
ODI	Pre	1.07 ± 0.69	1.10 ± 0.71	0.846
	Post	2.63 ± 2.42	1.13 ± 0.77	0.182
25-Hydroxyvitamin D (25(Oh)D)	Pre	2.57 ± 0.56	2.37 ± 0.49	0.124
	Post	4.07 ± 0.58	2.60 ± 0.85	0.000

Data presented as mean ± SD; P 0.05 considered as significant

The ethical consideration throughout included informed consent and confidentiality. Participants were randomly allocated to the experimental group (Group A), which received core stabilization exercises and 50,000 IU vitamin D weekly, or to the control group (Group B), which received the exercises and a placebo. Data was collected using VAS, Oswestry Disability Index (ODI), and 25-hydroxyvitamin D assay. Data was processed using SPSS version 26, and comparisons between groups using independent t-tests and data cleaning exercises to achieve accuracy were undertaken throughout.

3. RESULTS

The outcome reports a favorable change in the status of vitamin D, disability, and level of pain by utilizing a combination of core stabilizing exercises and vitamin D supplementation in the case of LBP. The level of pain (VAS), functional capacity (ODI), and 25-Hydroxyvitamin D all reduced significantly after therapy. The findings are congruent with other studies in favor of a combination of nutrition and exercise intervention rather than either form of intervention

Table 3: Within-group comparison of all variables (Wilcoxin)

Variable	Measures	Group CS-D (Mean Rank)	Group CS-P (Mean Rank)
VAS	Negative Ranks	14.50	8.90
	Positive Ranks	.00	2.50
	Z-value	-4.654	-3.410
	P-value	0.000	0.001
ODI	Negative Ranks	5.50	.00
	Positive Ranks	18.00	1.00
	Z-value	-2.917	-1.000
	P-value	0.004	0.317
25-Hydroxyvitamin D (25(Oh)D)	Negative Ranks	.00	.00
	Positive Ranks	13.50	3.00
	Z-value	-4.556	-2.121
	P-value	0.000	0.034

4. DISCUSSION

The results from this work, which studied the interaction between core stabilizing exercises and vitamin D supplementation on low back pain (LBP), align with existing publications recommending such interventions as a viable treatment regimen. Using a systematic procedure such as the NCID (Normalizing, Comparison, Interpretation, and Discussion) technique, we are then capable of examining the results on a more detailed scale, obtaining a general view on how such therapies work among each other and how they contrast relative to another study.

The NCID approach begins with standardizing the data for analytical purposes such that the variables are at the same scale. We normalized the groups in the present study by comparing the CS-D group (vitamin D supplementation plus core stabilization exercises) and the CS-P group (core stabilization exercises and placebos). Normalizing the groups allowed us to ensure that all the obtained data—pain (VAS), disability (ODI), and concentrations of 25-hydroxyvitamin D—be treated equally throughout in order to allow the comparison between groups to be valid.[4]

It can be seen that the groups (CS-D and CS-P) improved upon pain and functional capacity after the intervention, but that the CS-D group resulted in better outcomes. Specifically, the pain scores (VAS) considerably diminished in the CS-D group, which is similar to research such as that conducted by Jamil et al. (2023), who concluded that exercises for core stabilization were highly effective in reducing pain in

patients with chronic lumbar pain.[2] Moreover, Qaemshahar et al. (2020) also concluded similar results whereby combined interventions (exercises for the core and vitamin D) yielded higher improvements in the intensity of pain as well as quality of life, which is similar to the favorable outcomes seen in the current study.[5]

The inclusion of vitamin D supplementation showed a marked improvement in 25-hydroxyvitamin D levels in the CS-D group, which was not observed in the placebo group. This increase in vitamin D levels further supports the findings of Kumar Yadav et al. (2021), who highlighted the correlation between vitamin D deficiency and the severity of pain in chronic low back pain patients.[15]

The comparison section of the NCID method involves comparing the current study findings with those of previous research, focusing on whether the results align or deviate from established trends. In contrast to earlier research that only looked at vitamin D or core stabilization, this study looked at both of their effects together and found that they considerably improved pain and functional outcomes. The current study found that the combined treatment significantly reduced pain and disability, as well as enhanced vitamin D levels, reinforcing findings from various studies[6:]

Salik Sengul et al. (2021), who observed significant improvements in pain, functional impairment, and quality of life following core stabilization exercises, reported results consistent with our study. In this study, the experimental group (who received core stabilization exercises) demonstrated improvements in pain and disability (P = 0.01 for pain), which echoes the significant reductions in pain found in our CS-D group.[17]

Ali et al. (2021) and Habibian et al. (2023) showed that the core stabilization exercises combined with vitamin D supplementation yielded increased serum vitamin D concentrations and pain control.[20,21] This supports the noted elevation in the level of 25-hydroxyvitamin D in the CS-D group within our study, in which the findings revealed a significant improvement (Z = -4.556, P = 0.000). These results are also supported by Akbarnya et al. (2020), who also concluded that the supplementation with vitamin D combined with core stabilization exercises resulted in significant gains in pain intensity and quality of life (P = 0.01).[22]

The explanation part of the NCID approach lies in grasping the rationale and mechanisms for the results seen. Here, the joint effects of vitamin D and stabilization exercises applied to the core can be related to their separate contributions to treating different but related facets of low back pain that is chronic.

Vitamin D is crucial for bone health, immune function, and inflammation control. The increase in the level of the 25-hydroxyvitamin D observed in the CS-D group is in sync with the role played by vitamin D in musculoskeletal health maintenance. High pain sensitivity and muscle weakness have been linked with vitamin D inadequacy in patients with chronic low back pain. Pain and disability improvement in the CS-D group is most likely a result of the vitamin D supplementation in the improvement of the function of the muscles and the suppression of inflammation. This is similar to the findings by Patel et al. (2023), who showed that pain improvement and increased musculoskeletal strength were a result of vitamin D supplementation in patients with generalized low back pain.[4]

Core stability exercises are aimed at building the spine-supporting muscles that can help relieve pain associated with weak or dysfunctional muscles. The reduction in pain and disability seen in the CS-D group after core exercises is similar to past research such as Jamil et al. (2023), whose investigation revealed that patients with disc herniation exhibited enhanced muscular endurance and diminished lumbar pain after core stability exercises.[2] These exercises most probably gave the spine biomechanical support that improved its stability and diminished pain upon motion.

The simultaneous application of these interventions—core stabilization exercises and vitamin D supplementation—seems to produce a synergistic effect. What was seen from the study conducted by Sangatrashani et al. (2020) is that the combination of the exercise and supplementation produced larger improvements in pain and functional capacity in comparison to either intervention in isolation. The synergistic effect is presumably the result of targeting the physical and dietary factors that underlie the low back pain that is chronic.[23]

The Kolmogorov-Smirnov and Shapiro-Wilk tests in the current study revealed significant deviations from normality for key outcome measures (Pain VAS, ODI, 25(OH)D), suggesting that non-parametric tests would be more appropriate for analysing this data. This is consistent with the approach taken by Jamil et al. (2023) and Habibian et al. (2023), who faced similar issues and employed non-parametric statistical tests due to the non-normal distribution of their data.[2,20] The use of non-parametric tests ensures more robust conclusions in the face of non-normality, further validating the reliability of the present study's findings.

The correlation values in the current study align with findings from Ali et al. (2021) and Hao et al. (2021), though with some differences in strength. In the current study, the CS vit D group shows a moderate positive correlation of 0.246 between post-treatment ODI scores

and 25-Hydroxyvitamin D levels, which is statistically significant (P = 0.189). This indicates a moderate relationship between vitamin D levels and pain/disability reduction.[21,24] Hao et al. (2021) also found a positive correlation between vitamin D and pain relief, but Ali et al. (2021) found stronger correlations, suggesting varying strengths in the vitamin D impact across different populations.

5. LIMITATIONS

Our study was not without some limitations. Its eight-week intervention period might be insufficient to assess the long-term effects. We relied on self-reported tools like VAS and ODI, which can be subject to bias. We did not cater for lifestyle factors (e.g., diet, physical activity) that can affect the results. Lastly, there was a higher proportion of female participants (60%), which may limit gender-specific conclusions.

6. CONCLUSION

This study supports the combined effectiveness of core stabilization training and vitamin D supplementation in managing chronic low back pain. The results highlight the benefits of addressing both physical and nutritional factors for improved pain reduction and functional outcomes.

7. Data availability

The numerical data generated during this research is available with the authors.

8. Conflict of interest

All authors declare that there was no conflict of interest.

9. Funding

The study utilized the hospital resources only, and no external or industry funding was involved.

10. Authors' contribution

All authors took part in the conduct of the research as well as the preparation of the manuscript.

11. REFERENCES

1. Nicol V, Verdaguer C, Daste C, Bisseriex H, Lapeyre É, Lefèvre-Colau MM, et al. Chronic low back pain: a narrative review of recent international guidelines for diagnosis and conservative treatment. J Clin Med. 2023;12(4):1685. [PubMed] DOI: 10.3390/jcm12041685
2. Jamil MA, Bashir MS, Noor R, Niazi R, Ahmad N, Ahmad S, et al. Effects of core stabilization exercises on low back pain, disability and back muscle endurance in patients with lumbar disc herniation. Ann King Edward Med Univ. 2023;29(2):123-8. DOI: 10.21649/akemu.v29i2.5434
3. Aghamahalli AAS, Habibian M. The Survey of Vitamin D and C-Reactive Protein Status after a Period of Lumbar Stabilization Exercises and Vitamin D Consumption in Women with Chronic Non-Specific Low Back Pain. Tehran University of Medical Sciences; 2021. Summary
4. Patel L, Alagesan J. Correlation of Vitamin D and Core Stabilization Exercise in Low Back Pain: A Narrative Review. INTI J. 2023;2023. Full Text
5. Qaemshahar I. Evaluation of the Effectiveness of Core Stabilization Exercise and Vitamin D Intake on Pain and Functional Disability Levels in Women with Chronic Non-specific Low Back Pain. J Health Care. 2020;22(3):199-212. Full Text
6. Kumar M, Ahmed M, Hussain G, Bux M, Ahmed N, Kumar S. Assessment of Vitamin D Levels in Patients Presenting With Chronic Low Back Pain at a Tertiary Care Hospital. Cureus. 2020;12(12). [PubMed] DOI: 10.7759/cureus.11867
7. Saha S, Deb S, Singh M, Joshy VM, Pandey SK, Khare R, et al. Vitamin D status among patients with chronic low back pain attending a tertiary care hospital: A cross-sectional study. J Bone Joint Dis. 2022;37(3):119-24. DOI: 10.4103/jbjd.jbjd_24_22
8. Gorji SM, Samakosh MHN, Watt P, Marchetti PH, Oliveira R. Pain neuroscience education and motor control exercises versus core stability exercises on pain, disability, and balance in women with chronic low back pain. Int J Environ Res Public Health. 2022;19(5):2694. [PubMed] DOI: 10.3390/ijerph19052694
9. Hlaing SS, Puntumetakul R, Khine EE, Boucaut R. Effects of core stabilization exercise and strengthening exercise on proprioception, balance, muscle thickness and pain related outcomes in patients with subacute nonspecific low back pain: a randomized controlled trial. BMC Musculoskelet Disord. 2021;22(1):998. [PubMed] DOI: 10.1186/s12891-021-04858-6
10. Smrcina Z, Woelfel S, Burcal C. A systematic review of the effectiveness of core stability exercises in patients with non-specific low back pain. Int J Sports Phys Ther. 2022;17(5):766. [PubMed] DOI: 10.26603/001c.37251
11. Puntumetakul R, Chalermsan R, Hlaing SS, Tapanya W, Saiklang P, Boucaut R. The effect of core stabilization exercise on lumbar joint position sense in patients with subacute non-specific low back pain: a randomized controlled trial. J Phys Ther Sci. 2018;30(11):1390-5. [PubMed] DOI: 10.1589/jpts.30.1390
12. Akhtar RR, Ahmed R, Ashraf S, Ashraf O, Shafique U, Mureed A. Effect of Vitamin-D supplementation in adults presenting with chronic lower back pain. J Rawalpindi Med Coll. 2020;24(2). DOI: 10.37939/jrmc.v24i2.1399
13. Dzik KP, Skrobot W, Kaczor KB, Flis DJ, Karnia MJ, Libionka W, et al. Vitamin D deficiency is associated with

muscle atrophy and reduced mitochondrial function in patients with chronic low back pain. Oxid Med Cell Longev. 2019;2019(1):6835341. [PubMed] DOI: 10.1155/2019/6835341

14. Alagappan TR. Comprehensive Approach to Chronic Musculoskeletal Pain Management: Integrating Biopsychosocial Principles in Physiotherapy Practice. J Nat Sci. 2025;15(85):76391-99. Full Text
15. Yadav RK, Verma S, Jain S, Patra B, Neyaz O. Correlation between Vitamin D deficiency and nonspecific chronic low back pain: A retrospective observational study. J Family Med Prim Care. 2021;10(2):893-7. [PubMed] DOI: 10.4103/jfmpc.jfmpc_1478_20
16. Tatta J, Nijs J, Elma Ö, Malfliet A, Magnusson D. The critical role of nutrition care to improve pain management: a global call to action for physical therapist practice. Phys Ther. 2022;102(4):pzab296. [PubMed] DOI: 10.1093/ptj/pzab296
17. Sengul YS, Yilmaz A, Kirmizi M, Kahraman T, Kalemci O. Effects of stabilization exercises on disability, pain, and core stability in patients with non-specific low back pain: A randomized controlled trial. Work. 2021;70(1):99-107. [PubMed] DOI: 10.3233/WOR-213557
18. Worboys F, Hopkins A. Holistic management of pain. Lower limb and leg ulcer assessment and management. In: Lower Limb and Leg Ulcer Assessment and Management. Wiley-Blackwell; 2024. p:285-317
19. Elma Ö, Brain K, Dong HJ. The importance of nutrition as a lifestyle factor in chronic pain management: a narrative review. J Clin Med. 2022;11(19):5950. [PubMed] DOI: 10.3390/jcm11195950
20. Habibian M, Moosavi SJ, Davari A. The effect of 8 weeks of selected central stabilization exercises with vitamin D consumption on the quality of life and mental health of women with non-specific chronic back pain. Daneshvar Med. 2023;30(6):20-31. DOI: 10.22070/daneshmed.2023.16994.1294
21. Ali M, Uddin Z, Hossain A. Combined effect of vitamin D supplementation and physiotherapy on reducing pain among adult patients with musculoskeletal disorders: a quasi-experimental clinical trial. Front Nutr. 2021;8:717473. [PubMed] DOI: 10.3389/fnut.2021.717473
22. Akbarnya F, Habibian M, Moosavi SJ. Evaluation of the Effectiveness of Core Stabilization Exercise and Vitamin D Intake on Pain and Functional Disability Levels in Women with Chronic Non-specific Low Back Pain. J Health Care. 2020;22(3):199-212. Full Text
23. Sangatrashani SJH, Moosavi SJ. Effect of core stability exercise and vitamin D intake on liver enzymes activities in women with chronic low back pain. J Inflamm Dis. 2020;24(4):332-45. Full Text
24. Hao-Wei X, Shu-Bao Z, Yu-Yang Y, Chen H, Hu T, Shan-Jin W, et al. Relationship between vitamin D and nonspecific low back pain may be mediated by inflammatory markers. Pain physician. 2021;24(7):E1015. [PubMed]
25. Shekhar SPC, Babu JHK, Rajeswari T, Anumula SK, Gayatri B. Patients with low back pain benefit from core stability and motor control exercises. Int J Converg Healthc. 2023;3(1):25-32. DOI: 10.55487/ijcih.v3i1.103
26. Muisyo JM. Mechanical Pain Patterns and Risk Factors Associated with its Chronification among Patients with Non-Specific Low Back Pain at Nakuru Teaching and Referral Hospital. JKUAT-COHES; 2024. Available from: http://ir.jkuat.ac.ke/handle/123456789/6244

