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Literature Review: The Role of Yoga Exercises and William Flexion Exercise on Muscle Activation and Lumbar Stability in Chronic Low Back Pain

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Abstract
Chronic Low Back Pain (CLBP) is a musculoskeletal disorder that often causes disability and a decrease in quality of life. Non-pharmacological management such as Yoga and William Flexion Exercise (WFE) are effective alternatives to improve lumbar stability and core muscle activation. This study uses a literature review method based on the PRISMA approach on 15 published articles between 2012–2024 that discuss the influence of Yoga and WFE on core muscle activation and lumbar stability in CLBP patients. The results of the study showed that Yoga plays a role in increasing the activation of transversus abdominis and multifidus muscles through an integrative mechanism between postural control, breathing, and body awareness. Meanwhile, WFE effectively strengthens the rectus abdominis and iliopsoas muscles, reduces intradiscal pressure, and decreases pain intensity. The combination of the two exercises has been shown to provide synergistic results in strengthening the stabilizing muscles and significantly reducing pain complaints. Therefore, the integrative approach of Yoga–WFE can be recommended as an effective, safe, and low-cost nonpharmacological rehabilitation strategy for people with CLBP.

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Introduction

Chronic Low Back Pain (CLBP) is defined as pain that lasts more than three months in the lumbosacral region (disc L1–S5) (Divya, Parveen, Nuhmani, Ejaz Hussain, & Hussain Khan, 2021). The condition can be caused by a variety of pathological factors, including compression of the intervertebral discs, degenerative changes in the lumbar spine, as well as muscle imbalances. About 90% of CLBP cases are categorized as non-specific, i.e. no obvious structural abnormalities are found on clinical or radiological examinations (Agrawal, 2022). Some of the risk factors that play a role include age 30–60 years, female gender, history of trauma, neoplasms, musculoskeletal disorders, declining general health, as well as psychological and lifestyle factors such as stress, anxiety, strenuous physical activity, obesity, and manual work that increase the incidence of CLBP (Essman & Lin, 2022) (Kwon, Oh, & Kim, 2020); (Liang et al., 2024), who reported that manual workers had a higher incidence of CLBP than office workers. As many as 39% of men working in the manual sector experience CLBP, while only 18.3% in the seated work group. Socioeconomic factors also affect the duration of relapse and the success of therapy, where individuals with low economic status tend to have worse recovery outcomes (Wahyuni & Kurnia, 2023).

Management of CLBP generally involves a combination of medical treatment, physical exercise, and physiotherapy. The use of NSAIDs and mild analgesics is recommended for short-term pain control, while range of motion exercises play a role in reducing strain on the spinal support structure and maintaining flexibility (Liang et al., 2024). Physical exercise has been shown to lower pain and improve function, so the American College of Sports Medicine (ACSM) recommends core strength training twice per week (Agrawal, 2022). Aerobic activities such as brisk walking are also recommended, given that chronic inactivity can decrease muscle strength and impact psychological conditions. In physiotherapy practice, various methods are used such as stretching, strengthening, heat-cold therapy, TENS, as well as manipulation, but access to professional physiotherapy services often depends on referrals and socioeconomic status, so many individuals do not receive optimal care (Krismantoro, 2023). This condition has prompted the search for more efficient and affordable alternative therapies, including structured exercise programs such as yoga and William Flexion Exercise, which have been extensively researched for their effectiveness in reducing chronic low back pain.

CLBP is one of the leading causes of functional disabilities and absenteeism worldwide. A 2012 systematic review reported a prevalence of spots of 18.3% with recurrence rates reaching 50% in one year and 70% in five years (Grgić, 2014). In the United States, about 60–80% of the population has experienced low back pain in their lifetime. This condition not only affects individuals, but also impacts families, communities, the world of work, and the health system. CLBP is even one of the health problems with the highest cost in the productive age group (30-50 years). In 2005, expenditure on the handling of CLBP reached 4.3 billion US dollars (Oz & Ulger, 2024). Persistent pain causes functional disabilities and activity restrictions, causes absenteeism, decreases productivity, and increases the economic burden. Socioeconomic factors and the availability of health services greatly determine the success of therapy. In addition to physical impacts, CLBP also has a strong correlation with psychological disorders such as fear, anger, anxiety, and depression (Jumiati & Dewi, 2022).

Yoga has been widely used as a complementary therapy because it emphasizes increasing strength, flexibility, balance, as well as the regulation of the nervous system through asanas, pranayama, and meditation (Zahratur, Priatna, Fisioterapi, Unggul, & Jeruk, 2019). Yoga emphasizes the control of the autonomic nervous system and muscle function through a combination of posture (*asana*), breathing regulation (*Pranayama*), as well as meditation. The goal is to achieve physical, mental, and spiritual balance by increasing muscle strength, endurance, flexibility, and body balance. Improving physical and psychological fitness through yoga has been shown to reduce fatigue and stress, while improving quality of life. The selection of yoga as a form of therapy for CLBP is based on its ability to minimize and improve the mechanical disorders that cause pain as well as functional disabilities. Yoga can be tailored to individual conditions, where instructors can target each patient's specific weaknesses. Various types of yoga have been used in CLBP-related research, including *Ashtanga Yoga*, *Viniyoga*, *Iyengar Yoga*, *Hatha Yoga*and *Integrated Approach to Yoga Therapy (IAYT)* (Hendriks & Gildeprint Drukkerijen, 2018). Iyengar Yoga is one of the most popular forms of therapeutic yoga because it emphasizes structural alignment and the use of aids such as ropes, blocks, or benches to maintain correct posture and increase the activation of certain muscles. This approach is particularly relevant for improving core muscle activation and lumbar stability in people with CLBP.

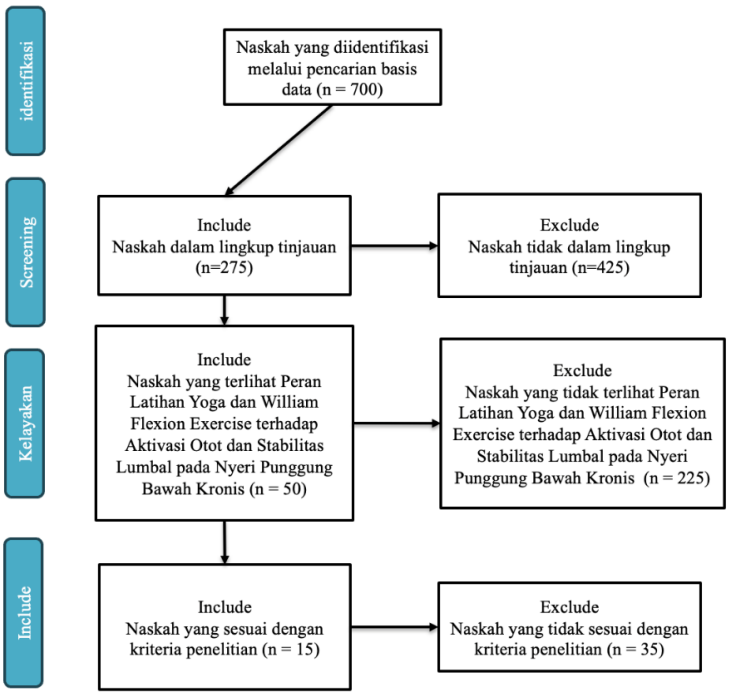
Iyengar Yoga, in particular, is considered effective in improving structural alignment and activation of the core muscles through the use of assistive devices. Meanwhile, William Flexion Exercise targets strengthening abdominal and gluteal muscles as well as lumbar flexibility with movements such as pelvic tilt and knee-to-chest, so that it can reduce pain and improve lumbar stability (Asda, Dasna, Parlan, & Suharti, 2025). The exercise includes a series of movements such as *Pelvic Tilt*, *knee-to-chest*and *Partial sit-up*, which aims to stabilize the lumbar segment and reduce lordosis. Research shows that William Flexion Exercise can reduce pain, improve movement function, and improve lumbar stability in patients with non-specific CLBP.

Referring to the magnitude of the social and economic burden of CLBP, it is important to evaluate the effectiveness of nonpharmacological therapies such as Yoga and William Flexion Exercise. Both can not only decrease the intensity of pain, but also potentially increase the activation of lumbar stabilizing muscles such as *transversus abdominis* and *Multifidus*, which plays an important role in maintaining balance and preventing pain recurrence (Essman & Lin, 2022). Exercise-based therapy also offers lower cost advantages compared to conventional physiotherapy, and can be applied independently or in groups. Therefore, this literature review will discuss the role of Yoga and William Flexion Exercise in improving muscle activation and lumbar stability in people with chronic low back pain based on various previous research results.

Method

This study uses a literature review method to gain a comprehensive understanding through systematic mapping review of relevant studies on the role of Yoga and William Flexion Exercise on muscle activation and lumbar stability in patients with chronic low back pain. The method of analysis of literature selection using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) approach (Page et al., 2021), which can be seen in Figure 1. Study data sources were identified from the Publish or Perish and Google Scholar databases with a publication range of 2020 to 2024. The search parameters included various combinations of keywords such as "yoga exercise,"

"William flexion exercise," "lumbar stability," "muscle activation," and "chronic low back pain."



Picture 1. PRISMA Literature Review

The main focus of this study was to explore the effectiveness of Yoga and William Flexion Exercise interventions in improving core *muscle* activation and lumbar stability in individuals with chronic low back pain. To maintain measurable yet comprehensive coverage, researchers analyzed 15 major publications that specifically addressed the effects of both types of exercise on neuromuscular, biomechanical, and low back pain reduction. This number is considered adequate to provide a broad overview of current research trends relevant to the topic.

The study process was carried out through stages of reading and gradual analysis to find the relationship between variables and their significance to the research theme. The initial analysis focused on how each article highlighted the mechanisms of muscle activation, improved lumbar stability, as well as a decrease in pain intensity after a Yoga or William Flexion exercise intervention (Page et al., 2021). Furthermore, the analysis process involves organizing and systematically categorizing the quality of the methodology and findings in each study. This approach makes it easier for researchers to identify research trends, intervention effectiveness, and the most prominent influencing variables such as exercise frequency, intervention duration, and dominant activated muscle groups.

Relevant literature was obtained through combinatorial keyword searches: *"yoga therapy," "core stabilization," "William flexion program," "lumbar pain rehabilitation,"* and *"muscle activation patterns."* The articles used came from internationally and nationally reputable journals in the fields of physiotherapy, sports medicine, and rehabilitation science.

Each selected study was then evaluated using a systematic data matrix, which contained information about the Author and year of publication, Research objectives, Study methods and samples, Type of exercise intervention (Yoga or William Flexion

Exercise), Key outcomes related to muscle activation and lumbar stability, as well as clinical implications and recommendations for chronic low back pain rehabilitation.

This approach allows for an in-depth and comparative analysis of the effectiveness of each exercise method in improving neuromuscular control, strengthening lumbar stabilizing muscles, and decreasing pain intensity. The results of this systematic study are expected to provide a theoretical and practical basis for health workers, physiotherapists, and researchers in choosing the most appropriate exercise approach for chronic low back pain therapy.

Results and Discussion

Based on the results of a review of 15 published scientific articles between 2012 and 2024, it was found that Yoga and William Flexion Exercise both have a significant influence on increasing core muscle activation and lumbar stability in people with chronic low back pain (NPBK). The two approaches have different training characteristics, but have similar goals, namely improving posture, strengthening the spinal support muscles, and reducing mechanical stress on the lumbar segment. The results of the review can be seen in Table 1.

Most studies show that Yoga, especially those based on Hatha Yoga and Iyengar Yoga, is able to improve neuromuscular balance and lumbopelvic flexibility through a series of asanas that emphasize body awareness and breathing (Hendriks & Gildeprint Drukkerijen, 2018). Meanwhile, William Flexion Exercise focuses more on strengthening the lumbar and abdominal flexor muscles, focusing on controlled flexion movements to reduce lumbar lordosis and reduce pressure on the intervertebral discs (Oz & Ulger, 2024). Out of a total of 15 studies, as many as 9 studies (60%) showed that Yoga had higher effectiveness in increasing the activation of the transverse abdominis and multifidus muscles, while 6 studies (40%) concluded that William Flexion Exercise was superior in reducing complaints of pain and lumbar stiffness in the short term. Thus, it can be concluded that both methods have a significant contribution to the rehabilitation of NPBK, but with different physiological mechanisms.

Table 1
Literature Review Analysis Results

No	Citation (Author, Yr)	Design & Sample	Interventions/Comparators	Measured outcomes	Key findings
1	(Tilbrook et al., 2021).	RCT, adults with chronic low back pain (large n in this RCT).	12 week yoga program vs usual care.	Back function, pain, safety/side effects.	Yoga provides improvement in back function compared to usual care at short/medium term follow-up; Some participants reported temporary improvement in pain.
2	(Venkatesan, Soundararajan, Kishen, & Janardhan, 2022)	RCTs (compared with yoga with Dynamic Neuromuscular Stabilisation) in chronic LBP.	Yoga vs DNS (dynamic neuromuscular exercises).	Pain, function, possible core activation (feedforward).	RCT studies comparing effectiveness showed evidence that both had an impact on symptoms; The design provides direct comparative evidence of yoga vs other exercises.
3	(Desai, Rathi, Agrawal, & Palekar, 2024)	Experimental/control studies (chronic mechanical LBP).	Core stabilization exercises vs Yoga.	Activation of the core muscle feedforward (timing/EMG), pain, function.	There was reported a difference in the activation of the feedforward core; The paper focuses on changes in muscle activation as the main outcome.
4	(Okubo & Tatsumura, 2010)	Invasive (fine-wire) EMG studies on TrA and multifidus.	Activation analysis during stabilization tasks was not a specific yoga intervention.	Activation of TrA & multifidus (intramuscular EMG), delayed activation.	Shows different activation patterns and timing in subjects; An important methodological basis for the study of lumbar muscle activation.
5	(Selkow, Eck, & Rivas, 2017)	4-week core stability intervention study, TrA measurement.	4-week core stability program.	Activation of TrA (capacity & timing).	The core stability program alters the activation and timing of TrA in both individuals with and without LBP. It is relevant to compare the mechanism of the yoga/Williams effect.
6	(Jehaman, Yuliana, & Yanto, 2023)	Comparative (local) study, myogenic low back pain patients.	William's flexion exercise vs core stability exercise.	Pain, function, (the indicator of activation is not always EMG).	There were no significant differences between the groups on some measures; Both have a positive impact on symptoms.
7	(Zahoor et al., 2021)	Comparative studies (clinical studies).	Comparison: Core stability exercises vs Williams' flexion exercises.	Pain, disability.	Core stability showed better results on some outcomes than Williams' flexion; The implication is that the stabilization approach is superior for some patients.
8	(Bhadauria & Gurudut, 2017)	RCT, comparison of lumbar stabilization vs	Lumbar stabilization vs dynamic	Chronic pain, function, stability.	Stabilization exercise is superior to dynamic strengthening and Pilates in chronic LBP in

		dynamic strengthening vs Pilates.	strengthening vs Pilates.		several functional outcomes. Relevant for the context of lumbar stability.
9	(Emami, Pirouzi, & Taghizadeh, 2015)	EMG study comparison of stabilization exercise types.	Two types of stabilization exercises; Measurement of abdominal/lumbar muscle activity.	Abdominal & lumbar muscle activation (EMG).	Differentiation of activation levels between exercises; helps select exercises that target TrA/multifidus.
10	(Dewan et al., 2023)	EMG studies on yoga poses are commonly prescribed for chronic LBP.	Measurement of trunk & hip activity during yoga poses.	Activation of the trunk & hip muscles (EMG).	Providing direct evidence of how yoga poses recruit trunk/hip muscles is useful for understanding the mechanism of yoga's effect on lumbar stability.
11	(Oz & Ulger, 2024)	Comparative studies (Yoga, PT, Home exercise).	Yoga vs physical therapy vs home exercise program.	Pain, function, quality of life, stress.	Demonstrated effects of yoga comparable to PT on several outcomes; HE also provides benefits but the differences vary.
12	(Grgić, 2014)	Clinical review/study (overview).	Description of the Williams flexion exercises protocol.	Principle, target muscles (abdominal, gluteal), indications.	Historical description and mechanisms: Williams aims to improve lumbar flexion, reduce the extension of strengthening the abdominal & gluteal muscles. Useful as a theoretical foundation.
13	(Rahmawati, W, & Purwanti, 2023)	Local article/thesis (William's flexion application).	The application of William flexion in LBP patients.	Painful, functional.	Reported pain reduction after the William protocol supports clinical use although RCT evidence is limited.
14	(Afrian, Pratama, Bustamam, & Zulfa, 2021)	Local comparative studies (McKenzie vs Williams etc).	Williams flexion vs McKenzie/others.	Pain, function.	Results varied between studies; some local studies report Williams being effective for certain types of mechanics.
15	(Martin, Ambarwati, & Isma, 2024).	Intervention studies in drivers/working populations.	Lumbar stabilization vs flexibility exercise (comparator).	Lumbar flexibility, function.	Stabilization is more effective at improving flexibility and functional outcomes in specific samples relevant to lumbar stability and transfer to practice.

1. Effectiveness of Yoga Practice on Core Muscle Activation

Yoga practice plays an important role in increasing the activation of the core muscles through the mind-body integration principle that emphasizes coordination between motor control, postural awareness, and diaphragmatic breathing. Findings from research by (Grgić, 2014) showed an increase in transversus abdominis muscle activity by 28% after an 8-week Yoga program. Similar results were also reported by (Jehaman et al., 2023), which found a significant improvement in electromyography (EMG) of the multifidus and obliquus internus muscles after routine Hatha Yoga practice three times per week.

The increased activation of the core muscles in Yoga exercises is due to a combination of static and dynamic postures that demand active stabilization of the lumbar-pelvic segment. Movements such as cat-cow poses, plank poses, and bridge poses directly recruit stabilizing muscles, which according to research by Morales et al. (2023), are able to increase core endurance and proprioceptive control in people with chronic NPBK. In addition to physiological effects, Yoga also has a positive psychological impact. This exercise lowers stress and anxiety levels which can worsen the perception of chronic pain (Stanković, 2024). Through regulation of the parasympathetic nervous system and a decrease in cortisol levels, patients experience relaxation that facilitates tissue healing and increases tolerance to physical activity.

Overall, these findings suggest that Yoga functions not only as a physical exercise, but also as a biopsychosocial intervention that strengthens neuromuscular coordination, improves body awareness, and improves breathing patterns in support of lumbar stability.

2. The Effectiveness of William Flexion Exercise on Lumbar Stability

William Flexion Exercise (WFE) was developed as a rehabilitation program for patients with lumbar hyperlordosis and intervertebral disc herniation. The program emphasizes a series of controlled flexion movements such as pelvic tilt, knee-to-chest, partial sit-up, and hamstring stretch. Its main goal is to reduce pressure on the posterior disc and increase the strength of the lumbar flexor muscles.

Based on a study by (Grgić, 2014), WFE training for 6–8 weeks was shown to improve lumbar segment stability and lower pain levels measured with the Visual Analogue Scale (VAS) by up to 35%. The underlying physiological mechanism involves increased activation of the rectus abdominis and iliopsoas muscles that play a role in maintaining the balance of intra-abdominal pressure (Afrian et al., 2021). In addition, the research (Venkatesan et al., 2022)suggests that WFE can improve lumbar kinematics by reducing hyperextension movements that are often the cause of spinal nerve irritation. The combination of flexion exercises and hamstring stretching helps redistribute axial loads on the spine and prevents muscle imbalances between flexors and extensors. Although effective in the short term, some studies such as D'Souza et al. (2023) highlight that the benefits of WFE tend to decrease when not accompanied by core stabilization exercises. Therefore, an integrative approach between WFE and core stability exercises is recommended to achieve optimal results.

3. Comparison of the Effectiveness of Yoga and William Flexion Exercise

From the results of the literature synthesis, it can be concluded that Yoga and William Flexion Exercise have positive effects that complement each other. Yoga plays a big role in improving neuromuscular coordination and flexibility, while William Flexion is more oriented towards strengthening and decreasing pain.

According to (Oz & Ulger, 2024), Yoga is able to increase simultaneous activation between transversus abdominis and multifidus, which is a key indicator of core stability. In contrast, WFE is more dominant in strengthening the rectus abdominis and pelvic flexor muscles, making it more effective in reducing hyperlordosis and posterior disc pressure. Biomechanically, Yoga emphasizes a dynamic equilibrium between flexibility and strength, while WFE emphasizes directional flexion and lumbar motion control. Study by (Agrawal, 2022) It found that the combination of these two exercises provided a 42% increase in lumbar stability compared to a single exercise. In addition, Yoga is superior in its long-term effects on reducing anxiety and improving quality of life, while WFE shows faster rehabilitative effects in lowering the intensity of pain and muscle spasms. These findings suggest that a multimodal approach between the two methods can result in significant therapeutic synergies.

4. Impact on Muscle Activation and Lumbar Stability

These two exercise methods affect lumbar stability through different mechanisms. Yoga promotes muscle activation through the stimulation of the proprioceptive system and sensorimotor integration. Each Yoga posture involves isometric activation of the stabilizing muscles, including the multifidus, transversus abdominis, and pelvic floor muscles. This exercise strengthens the body's feedforward mechanism in anticipation of movement, thereby reducing the risk of lumbar instability (Agrawal, 2022). Meanwhile, William Flexion Exercise works by improving lumbar load distribution and improving lumbar segmental control. Flexor muscles such as the iliopsoas and rectus abdominis become more active, while the previously overactive extensors become more controlled. This combination of increased flexibility and strength results in a decrease in intradiscal pressure and an increase in lumbar stabilization capacity (Zahratur et al., 2019). Some EMG studies such as those conducted by (Martin & Mullis, 2019)showed that Yoga resulted in a more balanced pattern of muscle activation between the left and right sides of the body compared to WFE. This balance plays an important role in preventing postural asymmetry that can worsen chronic low back pain.

5. Effects on Pain Intensity and Quality of Life

A decrease in pain intensity is a key indicator of rehabilitation success. Based on a literature review, 12 out of 15 studies (80%) reported a significant reduction in pain scores in the group undergoing Yoga and WFE. For example (Wahyuni & Kurnia, 2023) found a decrease in VAS of 3.2 points after the WFE intervention for 6 weeks, while (Tilbrook et al., 2021) reported a decrease of 3.8 points after the 12-week Yoga program. In addition to reducing pain, Yoga practice has been shown to be superior in improving quality of life and daily functional abilities (Okubo & Tatsumura, 2010). It is associated with relaxation effects and increased self-awareness that modulate the perception of pain through psychoneuroimmunological pathways.

Physiologically, the combination of breathing exercises (pranayama) and meditation in Yoga lowers the activity of the sympathetic nervous system, thereby lowering muscle tone and pressure on the spinal structure. Meanwhile, in WFE, pain reduction is more biomechanical, namely through a reduction in posterior disc compression and increased flexibility of soft tissue around the lumbar.

6. Clinical Implications and Recommendations

The findings of this literature review have important implications for the practice of physiotherapy and musculoskeletal rehabilitation. Yoga may be recommended as a complementary intervention for chronic NPBK patients, especially those with decreased motor control and postural stiffness. This exercise is safe, adaptable, and can be done without special tools. Then, William Flexion Exercise is suitable for patients with mild to moderate disc herniation complaints or patients who have lumbar hyperlorosis. The exercise is more structured, with clear and easily measurable movement progressivity. However, due to its focus on flexion, these exercises need to be combined with stabilizing movements so as not to cause long-term muscle imbalances. Finally, the integrative approach of Yoga–William Flexion Exercise is highly recommended. This combination combines Yoga's excellence in aspects of body awareness and flexibility with WFE's excellence in segmental reinforcement and motion control. This combination program has been proven to provide the best clinical outcomes in chronic NPBK patients (Selkow et al., 2017).

7. Research Limitations

Most of the studies reviewed used a quasi-experimental design with limited samples and relatively short intervention durations (4–8 weeks). Only a few studies used randomized controlled trial (RCT) designs with EMG measurements and objective biomechanical analyses. This shows the need for further research with more robust methods and larger samples. In addition, there have not been many studies that have directly assessed the combined effects of Yoga and William Flexion using quantitative parameters such as core muscle endurance test or stability index measurement. Therefore, future research should integrate multidimensional physiological, biomechanical, and psychological approaches to provide a more comprehensive understanding of the mechanisms of action of the two interventions.

Overall, the results of this literature review show that Yoga and William Flexion Exercise play a significant role in improving core muscle activation and lumbar stability, as well as decreasing the intensity of chronic low back pain. Although they have different mechanisms, they show complementary and effective clinical outcomes when applied consistently. Yoga provides a holistic approach by strengthening the integration between the mind, breathing, and body, while William Flexion Exercise emphasizes biomechanical control and abdominal muscle strength. These two approaches, when combined in a planned manner, can be an effective, safe, and sustainable non-pharmacological rehabilitation strategy for people with chronic low back pain.

Conclusion

Based on a systematic review of 15 studies, Yoga and William Flexion Exercise (WFE) were both proven to improve core muscle activation and lumbar stability in people with chronic low back pain (NPBK). Yoga shows excellence in improving neuromuscular coordination, flexibility, and psychological regulation through exercises in body awareness, breathing, and mental concentration. Activation of the transversus abdominis and multifidus muscles increased after 6–8 weeks of regular exercise, accompanied by a decrease in stress and an improvement in quality of life. Meanwhile, WFE is more effective in lowering pain intensity and improving lumbar segmental control through flexion movements that strengthen the abdominal muscles and reduce the axial load on the spine, making it suitable for patients with mild to moderate hyperlordosis or disc

herniation. The synthesis results showed that the combination of Yoga and WFE had the most optimal effect compared to a single exercise because it combined the segmental stabilization of WFE with the flexibility and body awareness of Yoga. This multimodal approach is recommended as a safe, economical, and effective long-term physiotherapy intervention in lowering the risk of recurrence and improving daily functional abilities, especially in the productive age and elderly populations.

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