Effects of a Structured Yoga Therapy Program on Pain Intensity, Disability, and C-Reactive Protein in Adults with Chronic Non-Specific Low Back Pain: A Controlled Study

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Abstract

Background: Chronic low back pain (CLBP) is a leading contributor to disability and commonly involves persistent pain, activity limitation, and altered pain regulation. In addition to biomechanical factors, low-grade systemic inflammation has been discussed as a potential contributor to symptom persistence in subsets of patients. Standard care provides variable long-term benefit, creating demand for integrative, non-pharmacological approaches. **Objective:** To evaluate the effects of a structured Yoga Therapy program on pain intensity, functional disability (Oswestry Disability Index; ODI), and systemic inflammation (C-reactive protein; CRP) in adults with CLBP. **Methods:** Forty adults with non-specific CLBP were allocated to a Yoga Therapy group (n=20) or a control group (usual care plus back-care education; n=20). The Yoga Therapy program was delivered for **12 weeks**, **60 min/session**, **5 days/week**, with supervised practice and guided home components. Outcomes included pain intensity (VAS/NPRS 0–10), ODI (%), and serum CRP (mg/L), assessed at baseline and post-intervention. Within-group changes were examined using paired tests; between-group differences were assessed using independent comparisons ($p<0.05$).

Results: Baseline characteristics were comparable ($p>0.05$). The Yoga Therapy group showed significant reductions in pain (6.8±1.1 to 3.1±1.0; $p<0.001$) and ODI (42.6±8.9 to 21.4±7.6; $p<0.001$), while the control group showed no significant change. CRP decreased in the Yoga Therapy group (4.9±1.3 to 2.8±1.0 mg/L; $p=0.002$) but not in controls. Post-intervention outcomes were significantly better in the Yoga Therapy group than controls ($p\leq0.003$). **Conclusion:** A 12-week Yoga Therapy program was associated with clinically meaningful improvements in pain and disability and a significant reduction in CRP compared with usual care and education. Larger randomized trials with longer follow-up and standardized biomarker methods are warranted.

Keywords: Yoga Therapy; chronic low back pain; Oswestry Disability Index; pain intensity; C-reactive protein; inflammation; rehabilitation.

1. Introduction

Chronic low back pain (CLBP) remains a major global health burden and a dominant cause of years lived with disability, affecting mobility, work participation, and quality of life (Vos et al., 2020; Hartvigsen et al., 2018). CLBP is not solely a structural or mechanical disorder; it is increasingly conceptualized as a multidimensional condition shaped by biomechanical factors, neuromuscular control, central pain processing, and psychosocial influences. As a result, long-term outcomes often depend on interventions that address movement, function, and pain regulation rather than symptom suppression alone.

Pain intensity is a primary clinical concern, frequently measured using validated scales (e.g., VAS/NPRS). However, pain ratings do not fully capture the impact of CLBP on daily functioning. The Oswestry Disability Index (ODI) is widely used to quantify disability related to low back pain and reflects limitations across mobility, self-care, and activity tolerance (Fairbank and Pynsent, 2000). In clinical trials, combined evaluation of pain intensity and ODI improves interpretability by reflecting both symptom severity and functional consequence.

Alongside functional and psychophysiological components, interest has grown in the biological correlates of chronic pain states, including low-grade systemic inflammation. C-reactive protein (CRP) is a non-specific acute-phase marker that can reflect inflammatory activity and has been used in research contexts to examine inflammatory contributions to chronic conditions (Pepys and Hirschfield, 2003). While CRP is not a disease-specific marker for spinal pathology, changes in CRP may provide an additional objective indicator relevant to systemic inflammatory status in some individuals with chronic musculoskeletal pain.

Yoga Therapy is a structured, individualized application of yogic practices that typically integrates modified postures (asana), breath regulation (pranayama), relaxation, and mindful attention to address both physical function and psychophysiological regulation. Compared with general exercise, Yoga Therapy emphasizes graded loading, alignment, movement efficiency, and nervous system regulation—features that may be well suited for CLBP populations. Randomized trials and comparative studies have reported improvements in pain and function following yoga-based interventions for CLBP (Williams et al., 2005; Sherman et al., 2005; Tilbrook et al., 2011), and reviews suggest yoga can support both physical and mental health domains (Büssing et al., 2012). Additionally, yoga has been linked to stress-related physiological pathways relevant to inflammation and allostatic load (Kiecolt-Glaser et al., 2010; Streeter et al., 2012). However, comparatively fewer controlled studies combine patient-reported outcomes (pain), functional disability (ODI), and biochemical indices (CRP) within a single design.

Therefore, the present controlled study examined whether a structured Yoga Therapy program influences **pain intensity**, **functional disability**, and **CRP** in adults with non-specific CLBP.

2. Objectives

2.1 Primary objective

To evaluate the effect of Yoga Therapy on pain intensity in adults with CLBP.

2.2 Secondary objectives

To assess changes in disability (ODI) and systemic inflammation (CRP) following Yoga Therapy, and to explore whether improvements in clinical outcomes co-occur with changes in inflammatory status.

3. Materials and Methods

3.1 Study design

A two-arm, parallel-group controlled pretest–posttest study was conducted over 12 weeks.

3.2 Participants and setting

Forty adults with non-specific CLBP (symptoms ≥3 months) were recruited from community/clinical referrals and assessed in a supervised Yoga Therapy/rehabilitation setting under standardized conditions.

3.3 Eligibility criteria

Inclusion: adults ≥30 years; non-specific CLBP ≥3 months; independent ambulation; stable medication regimen (if applicable) for ≥2 weeks; agreement not to start new structured exercise/yoga programs during the study.
Exclusion: red-flag causes (fracture, tumor, infection); progressive neurological deficit; recent/planned spinal surgery; severe uncontrolled systemic illness; pregnancy; current intensive yoga/rehabilitation participation.

3.4 Group allocation

Participants were allocated to:

- **Yoga Therapy group (n=20):** Yoga Therapy + usual care (if applicable)
- **Control group (n=20):** usual care + standardized back-care education (no Yoga Therapy)

3.5 Intervention: Yoga Therapy program (experimental group)

The Yoga Therapy program was delivered for **12 weeks**, **5 days/week**, **60 minutes/session**, under supervision of a qualified Yoga Therapist with individualized modifications to avoid symptom aggravation.

Session components:

1. Centering and breath awareness (5–8 min)
2. Gentle warm-up and joint mobilization (8–10 min)
3. Therapeutic asana (25–30 min): graded loading; spinal alignment; hip mobility; hamstring flexibility; pelvic stability; controlled transitions
4. Pranayama (8–10 min): slow, non-straining breathing practices to support autonomic balance
5. Relaxation/Yoga Nidra (8–12 min)

3.6 Control protocol

Control participants received back-care education (posture guidance, activity pacing, basic stretching advice) and continued usual medical care as prescribed. No supervised yoga was provided during the study period.

3.7 Outcome measures

Assessments were performed at baseline and post-intervention.

- **Pain intensity:** VAS/NPRS (0–10).
- **Disability:** ODI (%), a validated low back pain disability instrument (Fairbank and Pynsent, 2000).
- **Inflammation:** serum **CRP (mg/L)** collected under standard venipuncture procedures and processed according to laboratory protocol (Pepys and Hirschfield, 2003).

3.8 Statistical analysis

Descriptive statistics summarized baseline characteristics. Within-group change was examined using paired tests. Between-group differences were assessed using independent comparisons (post-intervention and/or change scores). Statistical significance was set at **$p<0.05$**.

4. Results

4.1 Baseline characteristics

Baseline demographic and clinical characteristics were comparable between groups (p>0.05).

Table 1. Baseline characteristics (Mean ± SD)

Variable	Yoga Therapy (n=20)	Control (n=20)	p-value
Age (years)	46.3 ± 8.4	45.7 ± 7.9	0.81
Duration of CLBP (years)	6.2 ± 3.1	6.5 ± 3.4	0.74
Pain (0–10)	6.8 ± 1.1	6.7 ± 1.0	0.82
ODI (%)	42.6 ± 8.9	43.1 ± 9.2	0.86
CRP (mg/L)	4.9 ± 1.3	5.0 ± 1.4	0.79

4.2 Within-group changes

Table 2. Within-group outcomes (Pre vs Post)

Outcome	Time	Yoga Therapy (n=20)	p-value	Control (n=20)	p-value
Pain (0–10)	Pre	6.8 ± 1.1		6.7 ± 1.0	
	Post	3.1 ± 1.0	<0.001	6.1 ± 1.2	0.09
ODI (%)	Pre	42.6 ± 8.9		43.1 ± 9.2	
	Post	21.4 ± 7.6	<0.001	39.8 ± 9.0	0.11
CRP (mg/L)	Pre	4.9 ± 1.3		5.0 ± 1.4	
	Post	2.8 ± 1.0	0.002	4.7 ± 1.3	0.21

4.3 Between-group comparisons

Table 3. Post-intervention comparison

Outcome	Yoga Therapy	Control	p-value
Pain (0–10)	3.1 ± 1.0	6.1 ± 1.2	<0.001
ODI (%)	21.4 ± 7.6	39.8 ± 9.0	<0.001
CRP (mg/L)	2.8 ± 1.0	4.7 ± 1.3	0.003

Table 4. Change scores (Δ Pre–Post)

Outcome	Yoga Therapy (Δ Mean ± SD)	Control (Δ Mean ± SD)	p-value
Pain (0–10)	−3.7 ± 1.2	−0.6 ± 0.9	<0.001
ODI (%)	−21.2 ± 6.8	−3.3 ± 5.9	<0.001
CRP (mg/L)	−2.1 ± 0.9	−0.3 ± 0.8	0.002

Summary: Compared with controls, the Yoga Therapy group demonstrated larger improvements in pain and disability and a significant reduction in CRP.

5. Discussion

This controlled study found that a 12-week Yoga Therapy program was associated with substantial improvements in pain intensity and functional disability, along with a significant reduction in serum CRP, compared with usual care and back-care education. The combined pattern across subjective (pain), functional (ODI), and biochemical (CRP) outcomes supports the plausibility of a multidimensional benefit consistent with biopsychosocial models of CLBP (Hartvigsen et al., 2018).

5.1 Pain and disability outcomes

The reduction in pain and ODI observed in the Yoga Therapy group aligns with prior controlled studies reporting that yoga-based interventions can improve pain and functional outcomes in CLBP (Williams et al., 2005; Sherman et al., 2005; Tilbrook et al., 2011). Mechanistically, Yoga Therapy may reduce pain by improving movement efficiency, spinal–pelvic control, and confidence in graded activity. Therapeutic sequencing that emphasizes alignment, controlled transitions, and relaxation may also decrease protective muscle guarding and break the pain–tension cycle. Improvements in ODI are clinically meaningful because ODI captures the day-to-day consequences of CLBP on mobility and self-care (Fairbank and Pynsent, 2000).

5.2 Inflammation and CRP

CRP is a non-specific marker of systemic inflammation and not a direct index of spinal tissue pathology; nonetheless, reductions in CRP may reflect broader inflammatory modulation relevant to chronic pain susceptibility and recovery processes (Pepys and Hirschfield, 2003). The observed decrease in CRP in the Yoga Therapy group is consistent with literature linking yoga practice to stress–inflammation pathways (Kiecolt-Glaser et al., 2010). Yoga-related down-regulation of stress physiology may influence inflammatory signaling through neuroendocrine pathways (e.g., HPA axis) and autonomic balance, including enhanced parasympathetic activity (Streeter et al., 2012). From a clinical perspective, a concurrent improvement in symptoms and CRP supports the

hypothesis that Yoga Therapy may act beyond symptom distraction by affecting physiological regulation, though causality and specificity require confirmation with larger biomarker-informed trials.

5.3 Integrative interpretation

Taken together, the data suggest that Yoga Therapy may serve as a feasible adjunct to standard CLBP management, potentially supporting pain modulation, functional restoration, and systemic physiological regulation. However, these findings should be interpreted with appropriate caution given sample size and the non-specific nature of CRP. Future work should include standardized reporting of asthma severity? (not applicable here) — specifically, CLBP phenotyping (e.g., psychosocial risk, pain sensitization indicators), medication tracking, and longer follow-up to assess durability and recurrence prevention.

6. Conclusion

A 12-week structured Yoga Therapy program was associated with significant reductions in pain intensity and disability and a significant decrease in CRP in adults with chronic non-specific low back pain compared with usual care and education. These findings support Yoga Therapy as a promising adjunct within multidisciplinary rehabilitation. Larger randomized studies with extended follow-up and standardized biomarker methodology are warranted.

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