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Research Article

Management of Low Back Pain with Alignment-Oriented Yoga Techniques and Self-Mobilisation of *Kukundara Marma* – Single Group Pre-Post Design Study

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Abstract

Background: Low back pain (LBP) is the most common health concern worldwide, frequently restricting daily activities and diminishing quality of life. Chronic LBP is usually attributed to sedentary lifestyles, poor posture, and extended sitting, and often fails to provide enduring relief through traditional treatments, despite its prevalence. This study examined whether a short-term, integrative approach involving alignment-focused yoga practices and self-mobilisation of *Kukundara Marma (*an Ayurvedic vital point corresponding to the sacroiliac joint) could offer meaningful improvement.

Methods: The study included 28 adults from Thiruvananthapuram, Kerala, who had been suffering from non-radiating low back pain for more than three months. After enrolment, 26 participants completed the full 14-day intervention. Each day, they received an individualised session combining alignment-based yoga and gentle *Kukundara Marma* mobilisation. This practice aimed to improve posture, core stability, and reduce tension in the lower back. The Visual Analogue Scale (VAS) was used to quantify pain levels, and the Oswestry Disability Index (ODI) was used to measure functional abilities. Data analysis was conducted with Jamovi software.

Results: Participants averaged 48 years old and were mainly females. After two weeks, pain levels dropped significantly (median VAS from 6 to 2), and disability scores improved (ODI from 26.3% to 11.9%), with statistically significant results ($p < 0.001$).

Conclusion: Combining yoga with Marma-based therapy yielded excellent results in pain and mobility. This integrative, low-cost, and non-invasive approach shows promise as a supportive addition to conventional care. Further research is needed through larger, controlled trials to understand its long-term benefits and potential for wider clinical use.

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KEYWORDS: Low Back Pain, Alignment-Oriented Yoga, Kukundara Marma, Marma Therapy, Functional Disability Index

1. INTRODUCTION

1.1. Background

LBP is a prominent cause of disability, affecting 619 million individuals worldwide in 2020 and an expected 843 million by 2050. It significantly impairs quality of life and function, with an age-standardised Years Lived with Disability (YLD) rate of 832 per 100,000 [1]. Low Back pain can be defined as pain or stiffness between the lower ribs and gluteal folds, with or without leg pain. [2,3]

1.2. Pathophysiology

The Global Burden of Disease Study 2019 demonstrates that modifiable lifestyle determinants, such as reduced physical activity, obesity, occupational stress, and psychosocial factors, significantly influence the persistence and progression of low back pain.[1] LBP arises from a complex interplay of biomechanical, degenerative, and neuromusculoskeletal dysfunctions, often involving intervertebral disc pathology, sacroiliac joint dysfunction, and associated soft tissue imbalances, compounded by modifiable risk factors such as poor posture, physical deconditioning, and psychosocial stressors. [4,5]

1.3. Guidelines for Management

As the first line of treatment, the WHO and ACP suggest non-drug, person-centred treatments like education, exercise, yoga, mindfulness, and manual therapies. Medications should only be used when necessary, with a focus on comprehensive, biopsychosocial care. [6,7]

1.4. Yoga for Chronic LBP

Research provides substantial data confirming the efficacy of Medical Yoga Therapy in enhancing pain thresholds and stimulating descending pain modulatory pathways in individuals with chronic LBP. [8] Studies report that both yoga and stretching helped ease symptoms and improve function in chronic low back pain, with benefits lasting up to 26 weeks, suggesting that while yoga's mind-body aspects add value, regular physical movement played the key role in relief.[9] Yoga has been demonstrated to substantially alleviate pain and enhance functional impairment in individuals with chronic LBP, with benefits maintained at follow-up and negligible side effects. [10]

1.5. Marma Therapy and Integration with Yoga

As described in classical Ayurvedic texts, *Marma* are anatomically defined vital points where muscles, veins, ligaments, bones, and joints converge—traditionally regarded as seats of life energy and increasingly explored for their therapeutic potential in integrative medicine.

Classical Ayurvedic scriptures describe Marma as anatomically defined vital places where muscles, veins, ligaments, bones, and joints intersect. They are considered life force centres and are increasingly studied in integrative medicine.[11] According to WHO's International Standard Terminologies on Ayurveda (ITA-3.16.44), *Kukundara Marma* is anatomically just inferior to the sacroiliac joint (SIJ), which stabilises the pelvis and transmits strain.[12] Owing to their close anatomical relationship and the continuity of fascial and ligamentous structures in this region, *Kukundara Marma* shows a notable structural and functional overlap with the SIJ. Sacroiliac joints transfer spine-to-lower-limb stress. Lumbopelvic stability depends on the thoracolumbar fascia, ligaments, and muscles. Small limb joint angles can affect sagittal vertical axis (SVA) readings. Posture is crucial for spinal alignment verification. [13,14]

1.6. Rationale: The purpose of this study is to fill in the gaps in current treatments for chronic low back pain by looking at an integrated, individualised, and culturally based therapy intervention. This method combines the biomechanical benefits of alignment-oriented yoga with the subtle energetic focus of Marma treatment. Its goal is to ease symptoms and encourage long-term functional recovery and overall health.

1.7. Aim: The goal of this study is to find out if alignment-based yoga practices and self-mobilisation of *Kukundara* Marma can help adults (20–60 years) with low back pain feel less pain and function better, as measured by the Visual Analogue Scale (VAS) and the Oswestry Disability Index (ODI).

2. METHODOLOGY

2.1. Trail Design: An observational study using a structured questionnaire for demographic data, followed by clinical examination about low back ache, along with VAS and ODI scales, was used to conduct the study in the Thiruvananthapuram corporation from July to October 2024.

2.2. Ethical consideration: The Ethics Committee of the Government Ayurveda College, Thiruvananthapuram, approved this study. On July 16, 2024, the Clinical Trials Registry of India registered the trial as CTRI/2024/07/070759.

2.3. Participants: Eligible participants (n=28) were recruited through a consecutive sampling process from the Swasthavritta outpatient unit of Government Ayurveda College, Thiruvananthapuram, or self-referred in response to community advertisements. The sample size was determined using a mean difference of 2.02 in VAS scores post-treatment, with a standard deviation of 3.4, at 80% power and 5% significance (two-tailed). This yielded a required sample size of 24.7, which was rounded up to 28 after accounting for a 10% dropout rate.

2.4. Inclusion criteria: Individuals aged 20–60 years with a clinical diagnosis of non-specific chronic low back pain, who consented to participate and had not engaged in yoga or stretching during the previous year, were included.

2.5. Exclusion criteria: Exclusion covered those using anti-inflammatory drugs, with prior lower limb injuries or surgeries, recent surgery or immobilisation, systemic illnesses, malignancies, low back pain secondary to other diseases, pregnancy, lactation, or excessive menstrual bleeding. [15]

2.6. Recruitment: Eligible individuals were recruited upon consenting to participate and attended an introduction session lasting about 60–70 minutes, with individualised sessions for 14

days. The process occurred in real time, meaning the intervention begins immediately once a participant is enrolled (without waiting for a whole batch of participants). VAS and ODI scores were reported before and on the final day after the intervention.

2.7. Interventions

2.7.1. Orientation and Individualisation. Before the commencement of the yoga sessions, all participants were thoroughly briefed regarding the intervention, including the sequence of practices, the use of props, safety considerations, and the importance of self-paced participation without strain or discomfort. Yoga practices and *Marma* mobilisation were adapted to each participant's posture, flexibility, and pain level using alignment cues, props, and guided modifications to ensure safe, effective, and individualised care. Proper alignment during yoga asana practice was maintained during Yoga sessions to prevent serious musculoskeletal and neurological injuries caused by misalignment, emphasising the importance of expert supervision and individualised instruction. [16] Participants practised yoga techniques and self-mobilisation of the *Kukundara Marma*, targeting improved core stability, flexibility, and mental relaxation. Sessions included breathing exercises, relaxation practices, and gradually challenging *asanas*, all tailored to individual capacities.

2.7.2. Yoga Practice Protocol

Each session began with five rounds of mindful deep breathing in *Samasthiti* (standing neutral alignment posture) to promote breath awareness and mental calm. This was followed by *Sookshma Vyayama*—gentle, coordinated joint movements with conscious breathing—to loosen the body and activate the musculoskeletal system in preparation for deeper practice.

Participants then performed 25 rounds of *Bhastrika Pranayama* for energisation, followed by Modified *Nauli Kriya* in *Tadasana,* involving gentle inward abdominal movements to stimulate core engagement and visceral massage. A short *Shavasana* allowed relaxation before progressing to alignment-focused standing postures— *Tadasana* with *Uddiyana Bandha*, *Ardha Uttanasana* with *Uddiyana Bandha*, and *Prasarita Padottanasana*—followed by another brief *Shavasana* to neutralise spinal load. The sequence continued with seated and supine *asanas—Baddha Konasana, Upavishta Konasana*, and *Setu Bandhasana*—emphasising flexibility and pelvic stability, with *Moola Bandha* engagement throughout. After another short *Shavasana*, the practice moved to *Shalabhasana,* followed by brief relaxation, and concluded with *Pavanamuktasana*, Supta *Baddha Konasana*, and *Anantasana*. A final extended *Shavasana* was included for complete physical and mental restoration, and the session ended with five rounds of *Bhramari Pranayama*. After the completion of the yoga practice, *Kukundara Marma* Mobilisation was performed through gentle stretching techniques, including Figure Four Stretch, *Ardha Pavanamuktasana*, Cat-Cow Movements, and Child's Pose, aiming to enhance sacroiliac joint mobility, pelvic stability, and further reduce low back discomfort.[17-19] To ensure safety and accessibility, props and physical supports were used for participants facing difficulty with specific postures.[20] Each posture was adapted to the individual's comfortable capacity, promoting a pain-free, individualised practice aligned with yogic principles. The study follows the Iyengar School of Yoga, and all *asanas* were performed accordingly. [21]

Table 1: Sequence of yoga techniques

Step	Practice	Rounds	Approximate Time (in minutes)
1	Mindful Deep Breathing in Samasthiti	5	3
2	Gentle Loosening Movements (Sookshma Vyayama)	3	5
3	Bhastrika Pranayama (Bellow,s breath)	25	5
4	Modified Nauli Kriya (in Tadasana- Mountain Pose) Modified Nauli kriya (abdominal churning) for beginners by pulling the anterior abdominal wall inside, holding, and releasing it slowly.	25	3-4
→	Short Shavasana (after Nauli)	1	2
5	Tadasana + Uddiyana Bandha (Upward Abdominal Lock)	3	3
6	Ardha Uttanasana (half-standing forward fold) + Uddiyana Bandha	3	3
7	Prasarita Padottanasana (wide-leg forward bend)	3	3
→	Short Shavasana (Corpse pose) (after standing postures)	1	2
8	Baddha Konasana (Butterfly Pose) + Moola Bandha	3	3
9	Butterfly Pose (Wide-Angle Seated Forward Bend) + Moola Bandha	3	3
10	Setu Bandhasana (bridge pose) + Moola Bandha (Root Lock)	3	3
→	Short Shavasana (after mild backbend)	1	2-3
11	Shalabhasana (Locust pose)	3	3
→	Short Shavasana (after Shalabhasana)	1	2-3
12	Pavanamuktasana (Wind Relieving Pose)	3	2-3
13	Supta Baddha Konasana (Reclining Bound Angle)	3	2-3
14	Anantasana (Side Reclining Leg Lift Pose)	3	2-3
15	Final Long Shavasana	1	5
16	Bhramari Pranayama (Bee breath)	5	3
17	Kukundara Marma Mobilisation (Gentle Stretches for sacro iliac joint)	4	5

Table 2. Sequence in the mobilisation of *Kukundara Marma*

Step	Mobilisation Technique	Repetitions / Duration	Approximate Time (in minutes)
1	Figure Four Stretch	3 on each side	2
2	*Ardha Pavanamuktasana*	3 on each side	2
3	Cat-Cow Movements	10 rounds	3
4	Child's Pose	Hold 1-2 minutes	2-3

2.8. Outcome Evaluation

Validated tools and scales were employed to assess the following:

2.8.1. Pain Intensity

The Visual Analogue Scale (VAS) was used to measure pain intensity. Participants noted their pain on a 10-cm horizontal line that goes from "no pain" to "worst pain imaginable." This was a simple, sensitive, and reproducible technique to measure symptom severity over time. [22]

2.8.2. Functional Disability Index

The Oswestry Disability Index (ODI) measured functional disability. This verified self-report questionnaire examines how low back discomfort impacts daily activities like movement, self-care, lifting, and socialising. From 0 to 100, the score indicates how disabled someone is: 0–20% means slight disability, 21–40% means considerable disability, 41–60% means significant disability, 61–80% means crippled, and 81–100% means bedbound or possibly exaggerating the disease. [23]

Statistical analysis

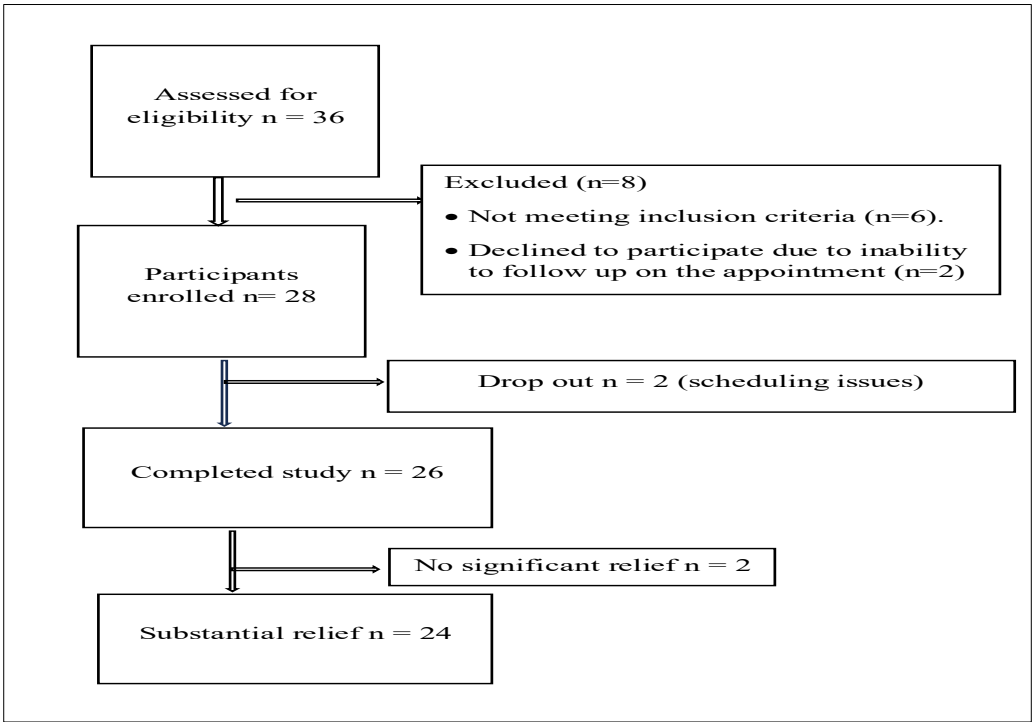
This research analysed the impact of alignment-oriented yoga and *Kukundara Marma* self-mobilisation on pain and disability of LBP. Pain was measured using VAS, and disability using the ODI. A Wilcoxon signed-rank test showed significant pain reduction, while paired t-tests for ODI and ODI% indicated improved functionWe set the level of statistical significance at $p < .05$ and utilized JAMOVI 2.5.3 to look at the data.

3. RESULTS

3.1. Participant Flow

We checked 36 people to see if they were eligible. Eight people were left out of the study: six didn't match the requirements for inclusion, and two chose not to participate. This left 28 people who were enrolled in the study. However, two participants withdrew because of schedule issues, leaving a final sample of 26 participants who completed the 14-day study protocol and subsequent assessments.

Eight were excluded—six for not meeting the inclusion criteria and two who declined to participate, resulting in 28 participants enrolled in the study. However, two participants dropped out due to scheduling conflicts, resulting in a final sample of 26 participants who completed the 14-day study protocol and post-intervention assessments.



3.2. Demographic Characteristics: The ages of the participants ranged from 24 to 59, with an average of 48.1 years. There were 18 women and 10 men in the study, which is 64.3% and 35.7%, respectively. There were 14.3% from the lower classes and 85.7% from the higher or upper-middle classes. The sample was mostly made up of cities (75%). The average body mass index (BMI) was 27.6±3.2. 14.3% had a healthy BMI, 60.7% were overweight, and 25% were obese.

Table 3: Baseline demographic data of the participants

Variable	Category	Frequency	Percentage (%)
Age (years)	21–30	2	7.1
	31–40	3	10.7
	41–50	9	32.1
	>50	14	50.0
Sex	Female	18	64.3
	Male	10	35.7
Socio-economic Status	BPL	24	85.7
	APL	4	14.3
Occupation	Manual Labor	12	42.9
	Housewife	10	35.7
	Employed	5	17.9
	Student	1	3.6
Education	10th Standard	5	17.9
	Plus Two	6	21.4
	Graduate	13	46.4
	Postgraduate	4	14.3
BMI Category	Normal	4	14.3
	Overweight	17	60.7
	Obese	7	25.0

3.3. Pain Intensity (VAS): Nineteen participants had at least one comorbidity (diabetes mellitus [DM], hypertension [HTN], dyslipidaemia [DLP], or thyroid dysfunction [TDF]). A total of 7 participants had two or more comorbidities among DM, HTN, DLP, and TDF. These conditions were self-reported and verified through available medical records. Among 28 participants, there was localised tenderness at 28.6% (n=8), and swelling was at 7.1% (n=2). Regarding pain duration, 14.3% (n=4) had symptoms for 3 months to 1 year, 67.9% (n=19) for 1–5 years, and 17.9% (n=5) for over 5 years, indicating a predominantly chronic pattern. On inspection, 92.9% (n=26) showed no visible spinal abnormalities, with swelling observed in 7.1% (n=2). Palpation revealed no tenderness in 75% (n=21), mild tenderness (GRADE-1) in 17.9% (n=5), and moderate tenderness (GRADE-2) in 3.6% (n=1). Most participants showed normal lumbo-sacral mobility. The median VAS score was initially recorded as 6 with an interquartile range (IQR) of 4.3 to 7, which was reduced to 2 after intervention, with an IQR of 1.8 to 4. This considerable decrease suggests a shift toward lower pain levels among participants. Using the Wilcoxon Signed Ranks Test, the study's results indicated a significant difference in the scores. The total number of participants was 26, with a Z value of 4.245 and a p-value of less than 0.001, showing strong statistical significance.

Table 4: Effect of Intervention on Pain Intensity: VAS Score Analysis (Wilcoxon Test)

	N	VAS score		Mean Rank	Sum of Ranks
		Median	IQR		
Negative Ranks	24	6	4.3 - 7	13.29	319
Positive Ranks	1	2	1.8 - 4	6	6
Ties	1				
Total	26				

Table 5: VAS Score Analysis contd

Wilcoxon Signed Ranks Test	
Z	4.245
p	<0.001

3.4. Functional Disability (ODI)

After the intervention, ODI dropped from 26.3% (SD = 18.3) to 11.9% (SD = 9.5). This drop indicates that the intervention improved functional skills and reduced back pain-related constraints. A paired t-test analysis of ODI scores revealed a mean difference of 14.7, standard deviation of 16.1, t-value of 4.667, and a significant p-value of <0.001. These statistical data show that the intervention reduces disability clinically and statistically.

Table 5: Effect of Intervention on Pain Intensity: ODI% % Score Analysis (Paired t test)

	N	**ODI%**		**Paired difference**		**Paired t-test**	
		Mean	sd	Mean	sd	t	p
Before	28	26.3	18.3	14.7	16.1	4.667	<0.001
After	26	11.9	9.5				

3.5. ODI Domain-wise Analysis

Across the domains, a notable improvement in median scores was observed following the intervention. The median score for pain intensity (ODI-1) decreased from 2.5 at baseline to 1 post-intervention. In the personal care domain (ODI-2), the median changed from 1 to 0. In lifting (ODI-3), the median shifted from 1 to 0.5. Walking (ODI-4) demonstrated a change from 1 to 0. Sitting (ODI-5) improved from 1.5 to 1. Standing (ODI-6) showed a reduction from 2 to 1. In the sleeping domain (ODI-7), the median changed from 0.5 to 0. The sex life domain (ODI-8) improved from 1 to 0. Social life (ODI-9) changed from 1.5 to 1, and travelling (ODI-10) from 1 to 0. This was closely followed by significant improvements in social life (ODI-9), which improved from 1.89 to 0.85 (a reduction of 1.05), and travelling (ODI-10), where scores decreased from 1.82 to 0.77 (also a reduction of 1.05). The sex life domain (ODI-8) demonstrated a substantial decrease as well, with scores dropping from 1.54 to 0.62. The mean total score on ODI before the intervention was 9.18, decreased to a mean post-intervention z-score of 7.12, reflecting an improvement in functional disability.

4. DISCUSSION

This study assessed the effectiveness of alignment-based yoga with *Kukundara Marma* self-mobilisation, showing significant pain relief and functional improvement using ODI and VAS.

4.1. Participant Profile and Risk Patterns. Most participants were over 50 years old (50%) and were predominantly female. The average BMI was 27.6± 3.2 which is quite alarming. Obesity levels are high in the sample, which denotes the current trend of this risk factor in our population. In 2021, an estimated 2.11 billion adults worldwide—1.00 billion men and 1.11 billion women—were affected by overweight and obesity, with prevalence exceeding 80% in several countries, reinforcing the urgency of addressing this escalating global health crisis. [24]

4.2. VAS score findings.

It was found that the VAS score showed substantial pain reduction, with a difference in median score of 4. Rank analysis reveals that, out of 26 participants, 24 experienced a negative rank (pain reduction), 1 showed a positive rank (pain increase), and 1 had no change (tie). The mean rank for negative ranks was 13.29, with a sum of ranks totalling 319, underscoring the overall trend toward pain alleviation.

4.3. ODI score analysis.

The ODI scores showed a marked improvement of 14.4 % difference in ODI scores, which highlights the intervention's effectiveness in enhancing functional status and reducing the adverse impact of low back pain on participants' quality of life. The overall reduction in ODI scores reflects the multifaceted benefits of combining alignment-based yoga with *Kukundara Marma* mobilisation.

4.4. ODI domain analysis.

Pain intensity (Domain 1) showed clear improvement, which reflects earlier findings that yoga can ease chronic low back pain by combining physical movement with mindful engagement, helping reduce discomfort and improve day-to-day coping.[25]

In Domain 2, addressing personal care, participants reported increased ease in activities such as dressing and grooming. These improvements may be attributed to better postural alignment and muscle activation, as poor sitting posture alters lumbar muscle activity and increases mechanical strain.[26]

Lifting ability (Domain 3) improved consistently, possibly due to enhanced trunk control and reduced biomechanical stress, as seen in structured exercise programs for sedentary workers. [27]

Walking (Domain 4) became more comfortable and stable, suggesting improved proprioception and gait control—benefits supported by studies linking yoga to enhanced balance and postural awareness in those with low back pain. [28,29]

Sitting ability (Domain 5) also improved somewhat due to initial participant variability. However, using upright alignment and mobilisation practices likely reduced spinal loading, echoing findings that prolonged unsupported sitting can exacerbate discomfort through altered load distribution. [30,31]

Standing ability (Domain 6) improved through the development of core stability and alignment, both of which were targeted through yoga postures involving sustained standing and symmetrical engagement. [27]

Notably, sleep quality (Domain 7) improved uniformly across the sample. Relaxation techniques, such as Bhramari Pranayama and *Shavasana*, likely enhanced parasympathetic activation and reduced discomfort at night. [32,33] Domain 8, concerning sexual activity, also showed improvement, which may be attributed to reduced pain, better pelvic alignment, and increased emotional well-being, as supported by studies on the holistic benefits of yoga. [34]

As pain and physical limitations eased, social life (Domain 9) improved, enabling greater daily participation—echoing evidence that yoga enhances both physical function and psychosocial engagement in chronic pain populations. [35]

Travelling (Domain 10) became easier, particularly for those with greater initial limitations, likely due to enhanced spinal mobility and core strength, reducing movement-related fear and discomfort. [30, 36]

4.5. Overall Appraisal of the Intervention Effects

The improvements likely reflect the multifaceted impact of alignment-oriented yoga, which targets posture, spinal alignment, core strength, and proprioception. [37,38]

Alignment-oriented yoga, which focuses on postural alignment and controlled movements, likely reduces pain and improves function by enhancing core stability and promoting musculoskeletal balance as seen in studies of Rosaria *et.al.*[39]

Stimulation of *Kukundara Marma*, associated with lower back strength and mobility, may have amplified yoga's effects by activating energy pathways for pain relief.

This yoga- and *Marma*-based approach offers a holistic, non-invasive alternative to conventional care, supporting self-directed pain relief and functional restoration. [40] With increasing interest in alternative therapies for chronic pain, this study offers valuable evidence supporting the integration of holistic approaches into mainstream pain management. [41]

These findings reinforce that individualised, alignment-focused yoga effectively improves musculoskeletal health and helps manage chronic pain. [42] Yoga alleviates pain and enhances well-being in chronic low back pain through mindful, awareness-based practices. The present results similarly indicate that physical alignment and mental focus play key roles in these improvements.[9] Future research could evaluate the long-term effects of integrating specific *Marma* points with yoga, including their potential to lower healthcare costs in chronic pain management. [43] Most participants (85.8%) had symptoms for>1 year, suggesting chronicity benefits from alignment-based interventions.

No adverse events occurred, supporting the intervention's safety and feasibility. The intervention aligns with WHO and ACP guidelines, promoting non-pharmacological management of chronic LBP. Breathwork, mindful movement, and *Pranic (vital force)* focus likely enhanced parasympathetic activity, reducing pain perception, while improvements in sleep and stress indicate broader systemic benefits. [44] Significant improvements were achieved in just two weeks, suggesting the potential for fast-track rehabilitative models. [45] The intervention required minimal equipment and can be easily scaled in community settings. [45] While short-term outcomes are encouraging, future research is essential to investigate the long-term sustainability of pain relief and functional improvements. With 75% urban participants and higher female participation (64.3%), sedentary lifestyle, reduced physical activity, and stress may have contributed to the LBP patterns observed. [46] Practices may have improved proprioception and body awareness, aiding self-correction of harmful postures during daily activities. [47-49] The intervention promoted patient self-efficacy in managing pain by encouraging active involvement over passive treatment approaches. [50]

4.6. Strengths of the Study

- A clearly defined protocol combining alignment-oriented yoga and traditional *Marma* mobilisation introduced a novel integrative model for CLBP care.
- Standardised outcome measures using VAS and ODI ensured a reliable quantitative assessment.
- Component-wise ODI analysis offered detailed insights into specific areas of functional improvement.
- The short 2-week intervention enhances practicality for outpatient or time-constrained settings.
- Individualised delivery ensured safety, optimised benefits, and reduced risk.
- High completion rate (92.8%) reflects strong feasibility and participant adherence.

4.7. Limitations

Even if this study has several good points, it also has some problems:

- The sample size was somewhat limited (n=28), constraining the generalizability of the results.
- The study's single-group pre-post analysis, lacking a control group, complicated the attribution of benefits to the intervention.
- Subjective reporting in VAS and ODI may be influenced by expectation or social desirability bias.
- There was no long-term follow-up to see if the advantages would last.

4.8. Recommendations.

Subsequent research must encompass bigger, randomised controlled trials including varied populations, accompanied by long-term follow-up to evaluate enduring outcomes and recurrence. Investigating additional *Marma* points alongside customised yoga protocols, and incorporating objective measures like goniometry, EMG, or biomechanical analysis, would enhance clinical insight. Qualitative methods can deepen understanding by capturing individual experiences and behavioural changes beyond quantitative metrics.

5. CONCLUSION

This study suggests a quick, integrated therapy employing alignment-oriented yoga and *Kukundara* Marma self-mobilisation for persistent non-radiating low back pain. Participants experienced significant relief from pain and improvements in daily function, as reflected in the reduced VAS and ODI scores. These findings suggest that restoring posture, enhancing body awareness, and promoting sacroiliac stability through an individualised mind-body practice can have tangible clinical effects. Functional gains were seen in key areas like lifting, walking, and sleep, pointing to the intervention's broad relevance to everyday life. Importantly, no adverse events were reported, and participants showed strong engagement, underscoring the approach's safety and accessibility. This aligns well with current international recommendations emphasising holistic, patient-centred chronic pain care. These early results are promising, but larger, longer-term experiments are needed to confirm and broaden them. Still, this work sets the stage for integrating traditional wisdom with modern therapeutics in addressing musculoskeletal health.

6. Confidentiality

The data collected were coded to maintain the confidentiality of the study subjects.

7. Author contributions

The authors' contribution in acquiring data and drafting the manuscript is as follows.

SS. Conceptualisation, Methodology, Investigation, Resources, Data Curation, Supervision, Validation, Formal analysis, Writing - Original Draft, Writing

MC Conceptualisation, Methodology, Data Curation, Supervision, Validation, Formal analysis, Writing- Reviewing and Editing, Original Draft, Supervision
MK Conceptualisation, Methodology, Data Curation, Supervision, Validation, Formal analysis, Writing - Original Draft, Writing- Reviewing and Editing, Supervision

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9. Declaration of generative AI in scientific writing
The authors used Grammarly to check spelling, punctuation, and grammar.

10. Declaration of competing interest
The authors declare that there is no conflict of interest.

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