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Original Article

Effectiveness of a Structured Yoga-Based Nursing Intervention on Low Back Pain Intensity in Female Patients Attending a Tertiary Orthopaedic Outpatient Department: A Quasi-Experimental Study

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Running Title: Yoga-based nursing intervention for low back pain in tertiary care

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Abstract:

Objective: To assess baseline pain, evaluate a nurse-led yoga intervention at two months, compare within- and between-group pain scores, and examine the associations between post-intervention pain and clinical variables in female patients with low back pain at an Indian tertiary orthopaedic outpatient setting.

Material and Methods: Sixty female patients with confirmed low back pain were sequentially enrolled into a study group (n=30) and control group (n=30) at SRM Medical College Hospital. The study group underwent a two-month supervised yoga program consisting of Bhujangasana, Shalabhasana, and Makarasana with monitored home practice. Controls received the usual care. Pain was assessed using the Numerical Pain Rating Scale at baseline and two months.

Results: Groups were comparable at baseline (study: 5.17±0.91; control: 5.00±0.98; "p-value" 0.499). At two months, the study group showed significantly greater pain reduction (1.83±0.95) versus controls (3.67±0.66; t=8.678; p-value<0.001; Cohen's d=2.21). Duration of low back pain was the only variable significantly associated with post-intervention pain (χ^2=8.261; "p-value" 0.016).

Conclusion: A structured, nurse-led three-asana yoga protocol produced clinically and statistically significant pain reduction with a very large effect size, supporting its integration into orthopaedic nursing practice.

Keywords: low back pain, nursing intervention, non-pharmacological pain management, numerical pain rating scale, quasi-experimental study

Introduction

One of the most widespread musculoskeletal disorders in the world and the major cause of years lived with disability in all ages is low back pain[1]. It affects people during their productive life and creates a heavy burden for individuals, families, and healthcare systems due to being chronic, recurrent, and cumulative, as it affects day-to-day functioning[2]. Low back pain has become a worldwide epidemic, with 619 million cases being estimated, and it is projected to increase further due to ageing populations and sedentary work habits[3]. In India, low back pain has

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become a growing problem due to rapid urbanisation, sedentary living, work-related stress, and poor ergonomic positions, with a prevalence of 6.2 to 92% in the various population studies[4].

The duration of symptoms is used to categorise low back pain into acute (less than six weeks), subacute (six to twelve weeks), and chronic (greater than twelve weeks). Subacute low back pain is commonly seen in the orthopaedic outpatient department and presents a critical treatment period. Without proper treatment at this stage, a significant number of cases can develop into chronic conditions, with related long-term disability and healthcare utilisation[5]. Patients come with limitations in the intensity of pain, limited spinal motion, and inability to perform normal functions[6]. In addition to the physical aspects of the condition, chronic pain correlates with mental suffering, a decrease in work productivity, and a decrease in health-related quality of life[7].

Low back pain treatment involves pharmacological and non-pharmacological approaches[8]. Pharmacological treatments such as analgesics, non-steroidal anti-inflammatory medications, and muscle relaxants are related to symptomatic relief but are linked to side effects such as gastrointestinal toxicity, risk of dependency, and limited potential to treat the underlying biomechanical causes of pain[9]. The existing literature-based clinical practice thus focuses on non-pharmacological approaches to managing non-specific low back pain as the primary management mode, with pharmacological management as an adjunct or short-term approach[10].

Yoga therapy has been a focus of research in the field of low back pain treatment, showing itself to be an effective, safe, and cost-effective treatment modality among non-pharmacological methods[11]. Yoga is a systematic mind-body practice that combines physical postures (asanas), pranayama (controlled breathing), and relaxation based on meditation[12]. It is, especially regarding the three asanas, well-suited in terms of biomechanical needs. Bhujangasana (cobra pose) enhances the lumbar extension range, the erector spinae, and paraspinal muscles. The under-chain muscles are activated by the practice of Shalabhasana (locust pose) and decrease the lumbar loading of flexion. Makarasana (crocodile pose) facilitates decompression of the spine and parasympathetic relaxation[13]. All these poses are aimed at treating the key biomechanical low-back pain deficits, such as paraspinal weakness, loss of spinal flexibility, and chronic musculoskeletal tension[14].

Nurses are the key frontline healthcare providers with a unique role in providing, overseeing, and supporting non-pharmacological interventions in clinical practice[15]. Nurses, being the medical

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professionals who spend the most time with patients in outpatient care, are well positioned to teach, model, and encourage compliance with therapeutic activities like yoga[16]. Yoga programs with a nurse-led approach have the potential to empower patients to be self-managed, hence facilitating effective treatment results and eliminating reliance on pharmacological management[17]. These interventions can also be emulated in both hospital and community settings and have great potential for primary and community nursing practice, which gives them high translational relevance[18,19].

The application of structured yoga-based interventions administered by nurses in a high patient-per-nurse caseload orthopaedic outpatient environment with low access to specialist physiotherapy services is one of the strategies of holistic pain management that can be scalable and resource-efficient in tertiary care settings with high patient-per-nurse caseloads in India[20]. Although there is increasing evidence on the role of yoga in the treatment of low back pain, no studies to date have compared the effectiveness of a standardised three-asana regimen (Bhujangasana, Shalabhasana and Makarasana) administered by nursing staff within an orthopaedic outpatient department in India. This is the gap in specific and unaddressed evidence that the current study aimed to address.

The study sought to: (i) determine the levels of pain in the female patients with low back pain in the orthopaedic outpatient department (baseline); (ii) measure the effectiveness of a nurse-led yoga-based intervention on pain levels two months later; (iii) compare the levels of pain within and between the study and control group; and (iv) establish the relationship between post-intervention level of pain and demographic and clinical factors.

Material and Methods

Study Design and Setting

A pretest-post-test quasi-experimental, quantitative study design was used to determine the effectiveness of a yoga-based nursing intervention on the severity of low back pain. The research was conducted at the Orthopaedic department, SRM medical college hospital and Research Centre (SRMMCH&RC), Kattankulathur, Tamil nadu, India between January 2024 and April 2024.

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Study Population and Sampling

The patients in the study population were females who had been clinically diagnosed with low back pain, confirmed by the orthopaedic outpatient department. The sample was purposively sampled (n=60) and allocated into a study (n=30) and a control group (n=30) using non-probability purposive sampling in accordance with previously set inclusion and exclusion criteria. Since the supervised yoga intervention was a group intervention, operational randomisation on the individual level was not feasible. The time-based sequential allocation technique was used: the initial group of eligible participants was allocated to the control group and the second successive group was allotted to the study group. The rationale behind this was to do so in order to reduce intergroup contamination and to have equal baseline conditions across groups.

Inclusion and Exclusion Criteria

Inclusion criteria: must be a female aged between 30 and 65 years, have had a clinical diagnosis of low back pain with the duration of symptoms for more than four weeks, must give written informed consent, must understand instructions in either Tamil or English, and must have the ability to engage in the simple physical activities necessary to perform yoga.

Exclusion criteria: acute spinal pathology (fracture, tumour or spinal deformity), lower extremity neurological deficiency, spinal surgery within two months, severe comorbid conditions contraindicating moderate physical activity, and enrolment in any other organized exercise or physiotherapy programme during the three months.

Data Collection Tools

A three-section expert-validated tool was used to gather the data. Section I captured social demographic characteristics: educational status, religion, occupation, family type, marital status, and monthly income. In Section II, there were clinical variables such as height, weight, history of low back pain, previous exercise history, and family history of low back pain. Section III measured the intensity of the pain with a single self-reported measure, the Numerical Pain Rating Scale

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(NPRS; 0 = no pain, 10 = worst imaginable pain), which is a well-validated one-item instrument to measure musculoskeletal pain intensity and has proven reliability and validity in clinical populations. Before the actual research, the tool was tested by a group of nursing and medical specialists.

Pilot Study

To determine the practicability, clarity, and feasibility of the yoga intervention protocol, a pilot study was conducted using 10% of the intended sample to assess the clarity and practicability of the protocol. Results validated the ability to conduct the study further and the relevance of the tools. Participants in the pilot study were not included in the regular study.

Intervention Protocol

The two groups were provided with normal orthopaedic outpatient care during the study. The study group also received a structured, nurse-administered yoga-based intervention that included three poses:

- **Bhujangasana (cobra pose):** This strengthens the paraspinal and erector spinae muscles, and enhances the range of lumbar extension of motion.
- **Shalabhasana (locust pose):** This pose stimulates the posterior chain muscles as well as decreases lumbar compressive load.
- **Makarasana (crocodile pose):** Allows the spine to decompress and stimulates parasympathetic mechanisms to relieve musculoskeletal strain and relax with ease.

The trained nurse researcher demonstrated each asana and then supervised the participants directly to ensure they were doing the asanas correctly, with the best possible alignment and safely. The participants were told to practice at home daily for two months while keeping a structured practice diary in order to monitor and record compliance. Periodic telephonic follow-up and reinforcement were provided to make sure that compliance was achieved and in case any

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difficulties were faced during the home-based practice. The control group was provided with normal outpatient nursing facilities in orthopaedics with no structured yoga program.

Outcome Measures

The main outcome was the intensity of low back pain, as evidenced by the NPRS at baseline (Day 1) and two months afterward at the very beginning of the intervention (Day 61). All measures were done by a common trained nurse researcher to ensure the consistency of measurements.

Statistical Analysis

SPSS version 26.0 was used to analyse the data. All variables were calculated using descriptive statistics such as frequency, percentage, mean, and standard deviation. The chi-square test was applied to compare baseline group data with the evaluation of the level of post-intervention pain and the other chosen demographic and clinical variables (Pain level). Paired t-tests were used to compare the pretest and post-test pain scores within the groups. Pain scores of the groups were compared with independent t-tests. Cohen's *d* (mean difference/pooled standard deviation) was used to calculate the effect sizes. A p value of less than 0.05 (two-tailed) was considered statistically significant.

Results

Baseline Comparability

The distribution of pain severity was the same in both groups at baseline, with 90.0% of the respondents in each group saying that they had moderate pain (NPRS 4 to 6); 10.0% said that they had mild pain (NPRS 1 to 3). None of the participants in either group reported the absence of pain, intense pain, or the worst possible pain. The chi-square analysis results showed that there was no statistically significant difference between the groups at baseline (chi-square = 0.000; p = 1.000), and thus homogeneity was ensured before the intervention began.

By post-test, there was a total shift in categories, with the study group showing 90.0% of the population experiencing mild pain and 10.0% experiencing no pain, with none of the participants

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staying in the moderate pain range. Conversely, 76.7% of the control group still had moderate pain, the same as previously. The chi-square of 37.765 (p value less than 0.001) shows a very significant difference between the post-test pain distributions in the groups (Table 1).

The pain score dropped by a mean of 3.34, with the mean baseline pain at 5.17 and the mean post-intervention pain at 1.83. The t-test between the two was highly significant (t=20.651; p value less than 0.001). The Cohen's *d* effect of 4.77 denotes a very large treatment effect, well above the minimum treatment effect of 2 points on the NPRS of low back pain (Table 2).

The control group had statistically significant yet substantially smaller pain reduction (mean difference: 1.33; Cohen's *d*: 1.57). This increase is in line with the well-characterised natural clinical course of subacute low back pain, regression towards the mean, and a Hawthorne effect due to the study participation and periodic assessment contact, and it does not decrease the much larger treatment effect in the study group (Table 3).

The mean difference between groups at the end of the test was 1.84 (t=8.678; p less than 0.001; Cohen *d*=2.21), and the difference between the yoga-based nursing intervention and standard care was very large and statistically significant. Baseline comparability was validated (pretest p=0.499). The research hypothesis (H_1) is accepted (Table 4).

All the demographic variables that were chosen did not show a statistically significant correlation with post-intervention pain level, proving that the targeted yoga-based intervention was equally effective among all the groups of demographic variables considered (Table 5).

Only duration of low back pain had a statistically significant correlation with the level of pain after interventions (chi-square=8.261; p=0.016). The greatest pain reduction was exhibited by participants with a period of six to twelve weeks of symptoms. Those who had chronicity of more than twelve weeks had attenuated improvement, meaning the sooner a person starts treatment, the more responsive they are to it (Table 6).

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Discussion

The current research indicates that a three-asana yoga-based intervention with a structured delivery by nurses can result in large and clinically significant decreases in the intensity of low back pain in the patient group admitted to a tertiary orthopedic outpatient department. The 3.34

points on the NPRS, which represents a within-group Cohen's *d* of 4.77, is significantly greater than the minimum difference in pain measurement on the NPRS that is considered clinically significant, which is 2 points, thus strongly demonstrating the clinical significance and therapeutic effectiveness of the three-asana protocol tested in this trial.

The three identified asanas have established neurophysiological and biomechanical mechanisms, which align with the experienced reduction in pain. Bhujangasana, Shalabhasana, and Makarasana are all known to strengthen the paraspinal and posterior chain musculature, enhance lumbar spinal extensibility, increase compressive loading on lumbar intervertebral discs, and activate parasympathetic pathways, which quiet central sensitisation and lower pain perceptions. These processes are in line with the available evidence indicating the effectiveness of posture-specific yoga protocols for low back pain. Medical yoga modulates pain; Arya et al. (2022) provided objective neurophysiological data on the changes in heart rate variability and electroencephalographic features as evidence of the sustained reduction in pain observed by the end of the two-month intervention period in the present study with medical yoga[21].

The current results align with those of Poojari et al. (2024), who also cited much greater reductions in pain levels with an integrated yoga therapy intervention than with the usual care in chronic low back pain patients in an Indian context[22]. Saleem et al. (2021) also specifically tested Salamba Bhujangasana and found it significantly improved pain levels and lumbar range of motion, which directly supports the mechanistic importance[23]. Biomechanical studies have corroborated the benefits of posterior chain activation and spinal decompression, further establishing the anatomical reason behind Shalabhasana and Makarasana in lumbar rehabilitation. The current trial builds on this body of evidence by showing, using a formal quasi-experimental design, that a three-asana nurse-administered protocol yields results similar to or better than those previously reported in studies that have utilized physiotherapy as the head of the yoga protocol and integrative medicine as the head of the yoga protocol, thus indicating that trained nursing personnel can provide effective yoga-based pain treatments in standard orthopaedic outpatient care.

The statistically significant within-group difference in the control group (mean difference: 1.33; Cohen's *d*=1.57) can be explained by the well-characterised natural clinical course of subacute low back pain, regression to the mean, and a Hawthorne effect due to the enrolment of

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participants in the studies and periodic measurement contact[24]. Importantly, the between-group mean difference of 1.84 points (Cohen's *d*=2.21) at the post-test level indicates that the yoga-based nursing intervention created a significantly greater effect in comparison to the natural recovery effect and non-specific study participation effect.

The fact that there were no significant associations between post-intervention pain level and all demographic variables confirms the hypothesis that the intervention can be broadly applied to different patient subgroups, without any need to demographise it[25,26]. The significant association between symptom duration and post-intervention pain level (p=0.016) provides a specific clinical decision-making rationale: the subacute window of six to twelve weeks from symptom onset represents the optimal period for initiation of structured nurse-delivered yoga intervention, before the neurophysiological and psychosocial processes sustaining chronic pain are fully established[27].

The practice and policy implications of the three-asana-based yoga nursing protocol include its cost-effectiveness and the requirement of only non-specialized equipment. Furthermore, it can be administered by any trained nurse using a standard outpatient consultation room, with home-based follow-up using a practice diary. Applicable to the Indian public healthcare setting where orthopaedic outpatient departments cannot offer physiotherapy but deal with large numbers of patients, this protocol presents a readily implementable, evidence-based, pharmacological-free pain management method that will make nursing personnel active therapeutic agents in pain prevention and management.

Limitations

The time-based sequential allocation, instead of concealed random allocation, in the quasi-experimental design restricts the rigour of causal inference and allows the possibility of selection bias to exist. The paper did not provide any background information on the sample included in the study, limiting the generalisation of the results to male patients, other age groups, and other units. The group size was 30 participants, and this is insufficient to have the statistical power to analyze subgroups. The use of adherence monitoring through self-reported practice diary brings about social desirability bias. The lack of objective functional disability indices (Oswestry Disability

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Index, Roland-Morris Disability Questionnaire), lumbar range of motion, and a post-two-month follow-up inhibits any comprehensive and sustainable evaluation of the outcome construct.

Conclusion

The current quasi-experimental study presents novel empirical data that a three-asana yoga-based intervention using Bhujangasana, Shalabhasana, and Makarasana, as delivered by nurses, substantially and statistically significantly (with a very large within-group treatment effect (Cohen's d=4.77)) reduced the intensity of low back pain in female patients presenting to a tertiary hospital. The intervention is practical, low-cost, culturally appropriate, and can be implemented by trained nursing personnel without using any specific equipment; thus, it can be directly applied to the standard orthopaedic outpatient nursing practice. Such a strong connection between a longer duration of symptoms and lower treatment responsiveness offers a certain evidence-based explanation of the importance of timely application of the structured yoga-based nurse intervention at the subacute stage, before the process of chronification takes place. Further randomised controlled studies with larger samples, male participants, objective functional outcomes, multicentre, and longer follow-ups are needed to produce a generalisable evidence base to integrate into national nursing practice guidelines.

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Conflict of Interest: The authors declare no conflict of interest.

Author Contributions:

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S.K: Conceptualisation, Methodology, Data Collection, Formal Analysis, Writing (Original Draft), Visualisation, Project Administration

S.T: Conceptualisation, Methodology, Supervision, Writing (Review and Editing), Resources

H.S. J.C: Supervision, Resources, Writing (Review and Editing)

Ethical Considerations: The Institutional Ethics Committee of SRM Medical college Hospital and Research Centre ((IEC Ref: 8726/IEC/2023) provided ethical clearance. All the participants were informed and provided written consent before their enrolment. Participants were part of the program on a voluntary basis. All participant data were kept confidential during the process of data collection, analysis, and reporting. The experiment was conducted in compliance with the Declaration of Helsinki (2013 revision) and the ethical principles of biomedical and health research with human subjects according to ICMR principles.

Data Availability Statement: The datasets generated and analysed during this study are available from the corresponding author on reasonable request.

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Table 1 Frequency and percentage distribution of pain levels at pretest and post-test in study and control groups (N = 60)

Timepoint	Pain Category	Study Group F (%)	Control Group F (%)	Chi-Square	p Value
Pretest	No pain (0)	0 (0)	0 (0)	0.000	1.000 (NS)
	Mild (1 to 3)	3 (10.0%)	3 (10.0%)		
	Moderate (4 to 6)	27 (90.0%)	27 (90.0%)		
	Severe (7 to 9)	0 (0)	0 (0)		
Post-test	No pain (0)	3 (10.0%)	0 (0)	37.7	less than 0.001 (S)
	Mild (1 to 3)	27 (90.0%)	7 (23.3%)		
	Moderate (4 to 6)	0 (0)	23 (76.7%)		
	Severe (7 to 9)	0 (0)	0 (0)		

NS= not significant; S= significant (p less than 0.05).

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Table 2 Pretest and post-test pain scores in the study group (n = 30)

Assessment	Mean	"S.D."	Mean Difference	t Value	p Value	Cohen's d
Pretest	5.17	0.91	3.34	20.651	less than 0.001 (S)	4.77
Post-test	1.83	0.95				

"S.D." = standard deviation; S= significant (p less than 0.05).

Table 3 Pretest and post-test pain scores in the control group (n = 30)

Assessment	Mean	"S.D."	Mean Difference	t Value	p Value	Cohen's d
Pretest	5.00	0.98	1.33	11.050	less than 0.001 (S)	1.57
Post-test	3.67	0.66				

"S.D." = standard deviation; S= significant (p less than 0.05).

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Table 4 Between-group comparison of pain scores at pretest and post-test (N = 60)

Timepoint	Study Group Mean (SD)	Control Group Mean "S.D."	Mean Difference	t Value	p Value	Cohen's d
Pretest	5.17 (0.91)	5.00 (0.98)	0.17	0.681	0.499 (NS)	0.18
Post-test	1.83 (0.95)	3.67 (0.66)	1.84	8.678	less than 0.001 (S)	2.21

NS= not significant; S= significant (p less than 0.05); "S.D." = standard deviation.

Table 5 Association between post-test pain level and selected demographic variables in the study group (n = 30)

Demographic Variable	Chi-Square	df	p Value	Significance
Age	3.069	4	0.546	NS
Educational status	0.858	2	0.651	NS
Religion	0.370	2	0.831	NS
Occupation	1.292	1	0.256	NS
Marital status	0.115	1	0.735	NS
Type of family	0.186	1	0.666	NS

NS= not significant (p greater than 0.05).

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Table 6 Association between post-test pain level and selected clinical variables in the study group (n = 30)

Clinical Variable	Chi-Square	df	p Value	Significance
Height	3.633	3	0.304	NS
Weight	2.615	3	0.455	NS
Duration of low back pain	8.261	2	0.016	S
Exercise history	0.115	1	0.735	NS

NS= not significant (p greater than 0.05); S= significant (p less than 0.05).

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