International Journal of Health Sciences and Research
Volume 14; Issue: 12; December 2024
Website: www.ijhsr.org
Original Research Article *ISSN: 2249-9571*

Effectiveness of Suryanamaskar on Pain Intensity, Muscle Strength, Function and Psychosocial Factors in Patients with Chronic Nonspecific Low Back Pain

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DOI: https://doi.org/10.52403/ijhsr.20241205

ABSTRACT

Non-specific low back pain is a common, potentially disabling condition usually treated with self-care and non-prescription medication. Yoga is a mind-body exercise used for chronic non-specific low back pain. Yoga can increase awareness of mental and physical states, which undo the physiological effects of negative emotions, broadens cognitive processes (e.g., having a broader perspective regarding problems), and build physical, social and psychological (e.g., self-empowerment) resources. It is culturally accepted in India and has traditionally been a part of daily routine meant for deeper relaxation due to its directional communication between the mental, nervous and musculoskeletal systems, making it one of the ideal therapies for chronic non-specific low back pain. Suryanamaskar is a part of a yoga program known to positively affect muscle endurance, obesity, flexibility and fitness. However, there is paucity of literature on effects of Suryanamaskar in treating low back pain.

Methods: Twenty- four participants with chronic nonspecific low back pain were recruited for 12 weeks Suryanamaskar. Primary outcomes were, pain intensity (VAS), muscle strength (BLC dynamometer), function (MODS) and psychosocial factors (Back PAQ). Data were analysed using Paired *t*-test.

Results: The pain intensity reduced by 2.76(0.79) cms (p= 0.00), Torso, leg and floor lift strength improved by 21.38(9.16),14.20(8.40), 13.07(6.71) in kgs, (p=0.00), the disability reduced by 13.17 (7.26) percentage (p = 0.00) and Psychosocial factors (attitude and beliefs) on Back PAQ scale improved from 1.50(4.75- 5.75) to 2.00(2.00- 6.50) {median [IQ range; 25-75]}.

Conclusion: Suryanamaskar was effective in reducing pain, improving strength of back muscle, function-like bending forward and prolonged sitting and standing and psychosocial measures in patients with chronic non-specific low back pain. Suryanamaskar can be considered as a treatment strategy for patients with chronic non-specific low back pain in India where it is popular and culturally acceptable.

Key words: Chronic nonspecific low back pain, strength, function, psychosocial factors, Suryanamaskar.

INTRODUCTION

Low back pain is a major problem affecting all age groups globally and is associated with sedentary occupations, smoking, obesity, and low socioeconomic status.[2] Morbidity caused by low back pain has increased exponentially by 50% since 1990, especially in low-income and middle-

income countries (LMICs).[1,2] Disability related to low back pain is projected to increase most in LMICs where resources are limited and access to quality health care is poor. Low back pain is classified as acute, subacute and chronic based on its duration, it's one of the leading cause for global socio-economic burden through direct or indirect costs.[3, 4]The European guidelines for the management of chronic nonspecific low back pain (CNSLBP) defines low back pain that is not attributable to a recognizable, specific pathology (e.g., infection, tumor, osteoporosis, fracture, structural deformity, and inflammatory diseases, such as ankylosing spondylitis, radicular syndrome, and cauda equina syndrome).[3]Mean point prevalence of CNLBP ranges between18.3% to 23%.[5], although there seem to be large variations related to economic status, gender, and age. [6] Despite recent advances towards the understanding of the underlying mechanism, CNLBP remains a disabling condition limiting daily activities of affected people.[7]

Inspite of multiple clinical guidelines providing similar recommendations for managing low back pain, a substantial gap between evidence and practice exists worldwide in high-income as well as low-income and middle-income countries[2, 5].There are various forms of traditional exercises such as Mckenzie exercises, pilates, motor control exercises and resistance exercises which shows a positive effect such as reducing pain, improvements in disability, anxiety/depression and strength all these exercises are good for CNLBP, with no superiority of one exercise group over the other. Lack of consensus on the appropriate management strategy for CNSLBP has led to use of complementary medicine as a choice of treatment for the CNSLBP. Approximately40% of patients with chronic back pain report using complementary and alternative therapies such as massage, yoga and acupuncture. Yoga has generated a huge interest and attention among the general public as an alternative treatment for a variety of chronic health conditions[8]. According to National Health Interview Survey data usage for complementary and alternative medicine (CAM) treatments has increased. In 2007, yoga was the 7th most commonly used CAM therapy. CAM therapies are used mostly to treat musculoskeletal conditions; in particular back pain[9].[10]

In Indian culture, Yoga has traditionally been a part of daily routine which is meant for attaining healthy life. *Ashtang* yoga, as described by *Maharishi Patañjali*, comprises of 8 stages viz. *yam* (code of conduct, self-restraint), *niyam* (religious observances, commitments to practice, such as study and devotion), *asana* (integration of mind and body through physical postures), *pranayam* (regulation of breath leading to integration of mind and body i.e. controlled breathing), *pratyahar* (abstraction of the senses, withdrawal of the senses of perception from their objects), *dharana* (concentration, one-pointedness of mind), *dhyan* (meditation) and *Samadhi* (the quiet state of blissful awareness, superconscious state).

Suryanamaskar, (Sun Salutation) sun adoration for health, efficiency and longevity is a part of Indian traditional yogic practices.[11] It involves pranayam, asana and upasana i.e. rituals. The sun salutation is performed as a cyclical event synchronized with a specific breathing pattern. Each cycle consists of 10 steps performed consecutively one after the other.

Practice of Suryanamaskar has become very popular amongst people, due to the benefits of aerobic exercise along with stretching of muscles and it is said to give more benefits with less expenditure of time.[10] Suryanamaskar revitalizes each and every cell of the body, gives physical strength, flexibility, mental calmness and reduces emotional stress, hence it is a holistic exercise that provides physical health benefits along with mental or emotional as well as spiritual benefits. The series of SN movements stretch the spinal column and upper and lower body through their full range of motion by alternately flexing the

body forwards and backwards. The weight bearing positions and alternative toning of muscles in the series may help to develop muscular strength and endurance. The series gives such profound benefits to the body that it is considered to be a complete yoga practice by itself. In this way, the practice of Suryanamaskar and its benefits in treating CNSLBP can be studied in depth so that it may offer an alternative approach to the treatment of low back.

METHOD

Twenty-four participants with non-specific low back pain from MGM musculoskeletal out-patient department, volunteered to participate in the study. Participants received 12weeks Suryanamaskar training programme. The training consisted of daily sessions, lasting 45 minutes which included 12 positions: Pranamasana, Hasta uttanasana, Hasta Padasana, Ashwa Sanchalasana, Parvatasana, Ashtanga Namaskara, Bhujangasana, Parvatasana, Ashwa Sanchalasana, Hasta Padasana, Hasta uttanasana, Pranamasana.

Individuals with clinically diagnosed chronic non-specific low back pain for 3 months or more, without any neurological signs were recruited in the study. Participants with stenosis, fractures, disc bulge, spondylolisthesis, inflammatory conditions, metabolic disorders, and posttraumatic conditions, cardiac or neuropsychiatric illness, history of major surgery or injury in the past, pregnant women, and patients with neurological complications were excluded

Signed informed consent was sought from all the participants before the study and institutional Ethical clearance was obtained from Ethical Committee for Research on Human Subjects (ECRH,), MGM Institute of Health Sciences, Navi Mumbai.

Assessment for pain intensity, Muscle strength, function and psychosocial factors were performed at baseline and after 12 weeks of interventions.

Assessment:

- Pain – Visual Analog scale
- Strength – Back leg dynamometer

1. Torso lift: the patient was asked to stand on the dynamometer, the dynamometer was set to zero and participant was asked to do lumbar flexion without bending knees by pulling the chain and maintain the position, three trials was taken and average readings were noted.

2. **Leg lift:** patient was asked to stand on dynamometer, it was set to zero and was asked to assume a sitting posture as if trying to sit on chair and then lift the chain, three trials was taken and average readings were noted.

3. **Floor lift:** patient was asked to stand on dynamometer, it was set to zero and patient was asked to assume position of lifting something from floor and then lift the chain, three trials was taken and average readings were noted.

- **Functional assessment:** Function was assessed using standard testing procedures of Modified Oswestry disability index. Psychosocial factor: Back pain related attitude and beliefs was assessed using back pain attitude belief questionnaire where participants was asked to mark the options (true / false) according to their attitude and belief regarding recovery from back pain.

PROCEDURE

The participants received training sessions six times a week (one session per week was under supervision) for 1hour/session for 12 weeks. The details of yoga posture are demonstrated in fig 1.

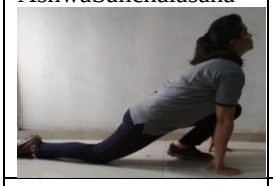
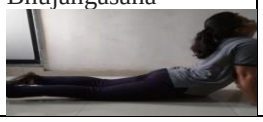
Figure: 1 – Suryanamaskar intervention

Figure: 2- Protocol for Yogasana: Training sessions were conducted thrice a week (one supervised session per week) for 1hour/session for 12 weeks.

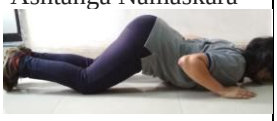
WEEKS	ASANAS NAME	DESCRIPTION	STEPS
1-2	Pranamasana 	Stand at the edge of your mat, keep your feet together and balance your weight equally on both the feet. Expand your chest and relax your shoulders. As you breathe in, lift both arms up from the sides, and as you exhale, bring your palms together in front of the chest in prayer position.	Participant was able to attend the asana as per the description.
	Hasta uttanasana 	Breathing in, lift the arms up and back, keeping the biceps close to the ears. In this pose, the effort is to stretch the whole body up from the heels to the tips of the fingers.	Participant was able to lift the arms up and close to the ears and was able to stretch the arms but was having difficulty in doing trunk extension.

	Hasta Padasana, 	Breathing out, bend forward from the waist keeping the spine erect. As you exhale completely, bring the hands down to the floor beside the feet.	Bending forward was restricted and touching hands to floor was not achieved.
	AshwaSanchalasana 	Breathing in, push your right leg back, as far back as possible. Bring the right knee to the floor and look up.	Participant can push left leg back as far as possible but bringing right leg ahead and looking up was difficult
	Parvatasana 	Breathing out, lift the hips and the tailbone up to bring the body into an inverted 'V' pose	Participant couldn't make a V pose as there was difficulty in full contact of palm and foot to the floor.
	Ashtanga Namaskara 	Gently bring your knees down to the floor and exhale. Take the hips back slightly, slide forward, rest your chest and chin on the floor. Raise your posterior a little bit. The two hands, two feet, two knees, chest and chin (eight parts of the body) should touch the floor.	Participants were not able to lift their hip off the floor and maintain the knee and toes contact. Most of it use to achieve full prone lying position.
	Bhujangasana 	Slide forward and raise the chest up into the Cobra pose. You may keep your elbows bent in this pose with the shoulders away from the ears. Look up at the ceiling.	Participants were able to raise the chest up on elbow and could look up.

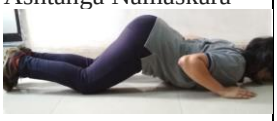
3-4	Pranamasana 	Stand at the edge of your mat, keep your feet together and balance your weight equally on both the feet. Expand your chest and relax your shoulders. As you breathe in, lift both arms up from the sides, and as you exhale, bring your palms together in front of the chest in prayer position.	Participant was able to attend the asana as per the description.
	Hasta uttanasana 	Breathing in, lift the arms up and back, keeping the biceps close to the ears. In this pose, the effort is to stretch the whole body up from the heels to the tips of the fingers.	Participant was able to lift the arms up and close to the ears and was able to stretch the arms and do moderate trunk extension
	Hasta Padasana	Breathing out, bend forward from the waist keeping the spine erect. As you exhale completely, bring the hands down to the floor beside the feet.	Bend forward as much as possible but couldn't touch the floor.

			
	AshwaSanchalasana 	Breathing in, push your right leg back, as far back as possible. Bring the right knee to the floor and look up.	Participant can push left leg back as far as possible but bringing right leg ahead and looking forward was difficult to maintain the balance.
	Parvatasana 	Breathing out, lift the hips and the tailbone up to bring the body into an inverted 'V' pose	Participant couldn't make a V pose as there was difficulty in full contact due to tightness.
	Ashtanga Namaskara 	Gently bring your knees down to the floor and exhale. Take the hips back slightly, slide forward, rest your chest and chin on the floor. Raise your posterior a little bit. The two hands, two feet, two knees, chest and chin (eight parts of the body) should touch the floor.	Participants were not able to lift their hip off the floor and maintain the knee and toes contact. Most of it use to achieve full prone lying position. Maintaining the poisition was difficult.
	Bhujangasana 	Slide forward and raise the chest up into the Cobra pose. You may keep your elbows bent in this pose with the shoulders away from the ears. Look up at the ceiling.	Participants were able to raise the chest up on elbow and could look up.

5-6	Pranamasana 	Stand at the edge of your mat, keep your feet together and balance your weight equally on both the feet. Expand your chest and relax your shoulders. As you breathe in, lift both arms up from the sides, and as you exhale, bring your palms together in front of the chest in prayer position.	Participant was able to attend the asana as per the description.
	Hasta uttanasana 	Breathing in, lift the arms up and back, keeping the biceps close to the ears. In this pose, the effort is to stretch the whole body up from the heels to the tips of the fingers.	Participant was able to lift the arms up and close to the ears and was able to stretch the arms but could do extension in, middle range
	Hasta Padasana	Breathing out, bend forward from the waist keeping the spine erect. As you exhale completely, bring the hands down to the floor beside the feet.	Bending forward achieved and fingers touching the floor was achieved

			
	AshwaSanchalasana 	Breathing in, push your right leg back, as far back as possible. Bring the right knee to the floor and look up.	Participant can push left leg back as far as possible but bringing right leg forward and look up maintain balance was difficult.
	Parvatasana 	Breathing out, lift the hips and the tailbone up to bring the body into an inverted 'V' pose	Participant could make V pose but was not able to maintain it
	Ashtanga Namaskara 	Gently bring your knees down to the floor and exhale. Take the hips back slightly, slide forward, rest your chest and chin on the floor. Raise your posterior a little bit. The two hands, two feet, two knees, chest and chin (eight parts of the body) should touch the floor.	Participants managed to do hip off from floor but 8 limbs in contact was not achieved.
	Bhujangasana 	Slide forward and raise the chest up into the Cobra pose. You may keep your elbows bent in this pose with the shoulders away from the ears. Look up at the ceiling.	Participants were able to raise the chest up on hands but with elbows slight bend and could look up.

7-8	Pranamasana 	Stand at the edge of your mat, keep your feet together and balance your weight equally on both the feet. Expand your chest and relax your shoulders. As you breathe in, lift both arms up from the sides, and as you exhale, bring your palms together in front of the chest in prayer position.	Participant was able to attend the asana as per the description.
	Hasta uttanasana 	Breathing in, lift the arms up and back, keeping the biceps close to the ears. In this pose, the effort is to stretch the whole body up from the heels to the tips of the fingers.	Participant was able to lift the arms up and close to the ears and was able to stretch and do inner range trunk extension.
	Hasta Padasana	Breathing out, bend forward from the waist keeping the spine erect. As you exhale completely, bring the hands down to the floor beside the feet.	Bending forward was achieved and participants could placed fingers on floor

			
	AshwaSanchalasana 	Breathing in, push your right leg back, as far back as possible. Bring the right knee to the floor and look up.	Participant can push left leg back as far as possible and placed other leg ahead and look up
	Parvatasana 	Breathing out, lift the hips and the tailbone up to bring the body into an inverted 'V' pose	Participant could make a V pose as and try to maintain the pose
	Ashtanga Namaskara 	Gently bring your knees down to the floor and exhale. Take the hips back slightly, slide forward, rest your chest and chin on the floor. Raise your posterior a little bit. The two hands, two feet, two knees, chest and chin (eight parts of the body) should touch the floor.	Participants were able to lift their hip off the floor and maintain the knee and toes contact but difficulty in maintaining chest contact.
	Bhujangasana 	Slide forward and raise the chest up into the Cobra pose. You may keep your elbows bent in this pose with the shoulders away from the ears. Look up at the ceiling.	Participants were able to raise the chest up on hands and look up.

9th, 10th, 11th and 12th week- Participants were able to perform step wise Suryanamaskar with ease

Table 1: Baseline parameters

Variables	**Experimental group n= 24**
Age (years)	31.70 (5.12)
BMI (kg/m^2)	24.24 (1.90)
Pain (VAS in cms)	4.67(0.73)

RESULTS

Analysis was carried out using statistical tool IBM SPSS (2015) version16. Statistical significance was set at $p \leq 0.05$. Pre and post intervention analysis using paired t-test for experimental group is presented in Table 2.

						95% confidence interval of the difference	
	Pre (n=24)	**Post (n=24)**	**Mean change**	**p value**	**Standard error**	**Lower**	**Upper**
Pain (VAS in cms)	4.67(0.73)	1.90(0.45)	2.76(0.79)	0.00*	0.16	2.42	3.09
Torso-strength (BLC dynamometer in kgs)	31.13(10.71)	52.52(8.67)	21.38(9.16)	0.00*	1.87	-25.25	-17.51

Leg-lift strength (BLC dynamometer in kgs)	31.20(9.50)	45.40(11.01)	14.20(8.40)	0.00*	1.71	-17.75	-10.65
Floor-lift strength (BLC dynamometer in kgs)	31.56(8.93)	44.64(10.12)	13.07(6.71)	0.00*	1.37	-15.90	-10.23
Function (MODS %)	24.09(9.41)	10.92(4.14)	13.17(7.62)	0.00*	1.55	9.95	16.38
Psychosocial factors (Back PAQ)	1.50(4.75-5.75)#	2.00(2.00-6.50)#		0.001^			

Table 2: Pre intervention - Post intervention analysis for experimental group
*** Using paired T test Using * paired t test Using ^Wilcoxon Sign Rank test**
Values expressed as Mean (SD), values expressed as Median (IQ)#
Key-BMI: Body mass index; VAS: Visual analog scale; BLC dynamometer: back leg chest dynamometer; MODS; modified Oswestry disability scale, Psychosocial factors – Back PAQ; Back pain attitude questionnaire.

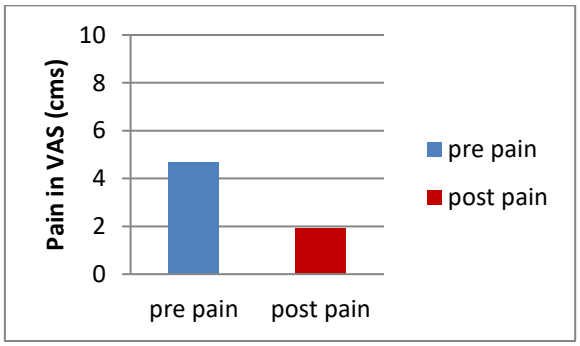


Fig 3: Comparison of pain level pre and post intervention

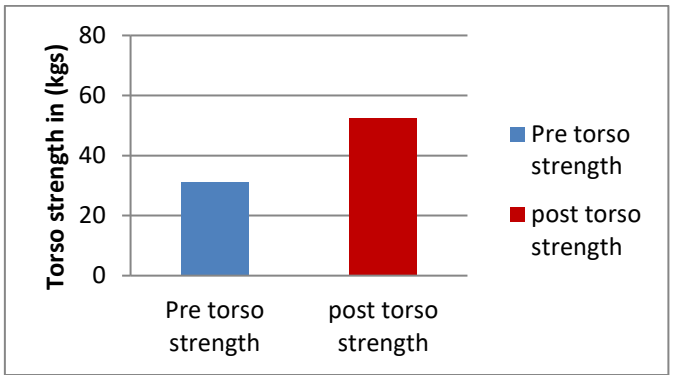


Fig 4: Comparison of torso strength pre and post intervention

Post intervention the pain intensity reduced by 2.76(0.79) cms. (p= 0.00), Torso, leg and floor lift strength improved by 21.38(9.16), 14.20(8.40), 13.07(6.71) in kgs, (p=0.00), the disability improved from 1.50(4.75-5.75) to 2.00(2.00- 6.50) {median [IQ range; 25-75].

DISCUSSION

The experimental design aimed to study the effect of Suryanamaskar on pain intensity, muscle strength, function and psychosocial factors in patients with CNSLBP. The results depicted significant improvement in pain intensity, muscle strength, function and psychosocial factors after 12 weeks of Suryanamaskar.

Suryanamaskar is a comprehensive yoga technique which incorporates physical activity, breath regulation, relaxation and awareness which aim to comfort. The improvement in pain was because of physiological changes that causes increase in para- sympathetic nervous system activity which activates their coping strategies and perception of pain , release of endogenous opioids like endorphins and enkephalin (pain inhibitors) , increase in flexibility, strength, circulation and cardio respiratory capacity.[13] Deep relaxation of the spinal muscles achieved during safe body movements with mindful awareness form the basis of improvement observed in pain and flexibility within this short period of intervention.[14]Yoga produces increased kinaesthetic awareness of physical states. Body awareness is a multi-dimensional construct that entails a combination of proprioceptive and interoceptive awareness (Mehling et al., 2012)[15.] Since most types of yoga based practice (YBP) emphasize attention to proprioceptive and interoceptive signals, it can be hypothesized that they are an efficient method for fine-tuning body awareness.

It is found that, Yoga practitioners have more gray matter volume (GMV), expressed as percent of total intracranial volume, in a number of regions including the insula, cingulated cortex, medial prefrontal cortex, inferior and superior parietal lobule, as well as increased intra-insular white matter connectivity. Moreover, insula GMV correlated positively with pain tolerance (left and right insula) and years of yoga practice (left insula only). Self-reports of strategies used to tolerate pain revealed that yoga practitioners used much more ‘‘embodied’’ approaches (e.g., focusing on the breath, attending to the sensation, observing the pain without reacting etc.) compared to controls(e.g., trying to ignore the pain and distract oneself).Taken together, these findings suggest that increased pain tolerance in yoga practitioners was a consequence of adaptive insular changes, mediated by increased parasympathetic activity and interoceptive processing.[16] It improves disability through a complex interaction of physiological ,psychological and emotional pathways. Yoga confers the physical benefits of increased core strength and stabilization, which are essential for back health. Yoga helps break the fear avoidance cycle by serving as a form of gradual, guided exposure to movement and activity. Indeed which helps patients to respond to pain and stiffness with gradual movements and improves their function.[8] It has also been shown to increase the frequency of positive emotions, which undo the physiological effects of negative emotions, it broadens cognitive processes (e.g. having a broader perspective regarding problems), and build physical (e.g., improved health), social (e.g., improved social support) and psychological (e.g., self empowerment) resources.[17]

Suryanamaskar involves movements of all body segments, there is alternating flexion and extension movements of the spinal column through its maximum range which strengthens and enhances the flexibility of spine.[18] Suryanamaskar has direct impact on muscles and it helps improve the size, strength, endurance and flexibility.[11] Many of its poses build strength in back muscles because they require sustained contractions of particular muscle groups, poses like Hastauttanasana, Hasta Padasana, Ashtanga Namaskar and Bhujangasana improve the strength of back muscles and flexibility of spine which is comparable to resistance training.[16] Combination of contraction and stretches may be responsible for improving the viscoelasticity which in turn improves tissue extensibility.[19]This all could contribute to improvement in torso strength in Suryanamaskar group (p= 0.000).

Similar results were found in study done by Bhutkar M et al (2011) where 88 healthy students performed 24 cycles of Suryanamaskar 6days/24 weeks and showed improved muscle strength and general body endurance.[20] Vaibhav Amit *et al* (2016) studied the effect of Suryanamaskar on body, which showed improvement in

metabolic function, strength and flexibility of musculoskeletal system, balanced endocrinal system and tuned central nervous system.[12]

Suryanamaskar does not require any tools or gadgets, limited space is enough to perform and it only takes few minutes to complete the cycles. It can be the perfect solution for time-challenged individuals making it seemingly beneficial and self- directed technique to improve strength, body composition and general body endurance. Suryanamaskar could provide superior compliance and benefit in long term compared to traditional exercise programs as yoga poses once learned, might be more easily remembered by patients because the poses and their associated names tend to have universal recognition. For individuals without access to adequate health-care, Yoga is absolutely a more cost-effective treatment for CLBP. Yoga due to its directional communication between the mental, nervous and musculoskeletal systems, is considered as one of the ideal therapy for chronic nonspecific low back pain.

Suryanamaskar application and versatility make it one of the most useful and complete form of yoga which is based on three elements: rhythm, energy and form. Form is evident in 12 postures whereas steady and continuous performance of postures coordinated with breath reflects the rhythm and energy which all activates the psychic body in a completely different way than other form of exercises. It is claimed that Suryanamaskar practice gives benefits of both asana and pranayama which improves general health and fitness.

CONCLUSION

Suryanamaskar was effective in reducing pain, improving strength of back muscle, function-like bending forward and prolonged sitting and standing and psychosocial measures in patients with chronic non-specific low back pain.

Clinical implication

The study findings implicate use of Suryanamaskar as an effective and economical intervention in the treatment of chronic nonspecific low back pain. Suryanamaskar can be introduced as a treatment strategy after the patient undergoes initial triage which would screen him/her for red flags. Better adherence to this asana would yield enhanced treatment outcome and aid faster rehabilitation with minimal supervision for time challenged individuals.

Declaration by Authors

Ethical Approval: Approved

Acknowledgement: None

Source of Funding: Nil

Conflict of Interest: Nil

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How to cite this article: Anuja S Surve, Anisha D Gulati. Effectiveness of Suryanamaskar on pain intensity, muscle strength, function and psychosocial factors in patients with chronic nonspecific low back pain. *Int J Health Sci Res.* 2024; 14(12):42-53. DOI: *https://doi.org/10.52403/ijhsr.20241205*

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