



Research Article

**EFFECT OF YOGA THERAPY ON QUALITY OF LIFE AND ANXIETY IN OSTEOARTHRITIS OF THE KNEE JOINT - A RANDOMIZED CONTROL STUDY**

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Received on: 28/11/2014

Revised on: 15/12/2014

Accepted on: 28/12/2014

**ABSTRACT**

**Aim:** To evaluate the impact of adding Integrated Approach of Yoga Therapy (IAYT) to therapeutic exercises in osteoarthritis (OA) of knee. **Materials and Methods:** This is a prospective, randomized, active controlled trial. Two hundred and fifty participants with OA of knee joints, between 35 and 80 years of age, were randomly assigned to receive yoga or physiotherapy exercises after transcutaneous electrical stimulation and ultrasound treatment of the affected knee joints. Both groups practiced supervised intervention (40 min/day) for 2 weeks (6 days/week) with follow-up for 3 months. **Results:** There were significant differences within ( $P < 0.001$ , Wilcoxon's) and between groups ( $P < 0.001$  Mann-Whitney U) in all domains of the Short Form 36 (SF-36) and state trait anxiety inventory (STAI)-1 and STAI-2, with better results in the yoga group than in the control group on both day 15 and day 90. **Conclusion:** Study showed that the IAYT is better than therapeutic exercises as an adjunct to transcutaneous electrical stimulation and ultrasound treatment in improving knee disability and quality of life, and in the reduction of anxiety in patients with OA knees.

**KEYWORDS:** Anxiety, Integrated yoga therapy, Knee disability, Osteoarthritis, Yoga.

**INTRODUCTION**

Osteoarthritis (OA) is the second most common rheumatological problem in India and has a prevalence rate of 5.8%.<sup>[1]</sup> It is characterized primarily by articular cartilage degeneration and secondarily by a peri-articular bone response.<sup>[2,3]</sup> The worldwide prevalence rate of OA is 20% for men and 41% for women, and it causes pain or dysfunction in 20% of the elderly population.<sup>[4]</sup> Relieving pain, stiffness and improving physical functions are the important goals of present-day therapy.<sup>[5,6]</sup> The management of OA is still far from optimal result here with as the medications currently available provide only limited symptomatic relief and are fraught with a number of side effects.<sup>[7]</sup> It is increasingly recognized that a key outcome measure for any healthcare intervention for OA is improvement in health-related Quality of Life (QOL).<sup>[8,9]</sup> Researchers observed greater increases in Short Form 36 (SF-36; the questionnaire used to assess the QOL) after the patients with OA knees received treatment.<sup>[10,11]</sup> It has been found that patients assigned to arthroscopic surgery, did not show much improvement in health-related QOL.<sup>[12]</sup> Role

of yoga in the improvement of QOL of patients with chronic low backache, showed that in the yoga group, there was significant improvement in the scores of World Health Organization Quality of Life (WHOQOL)-brief on all domains.<sup>[13]</sup> Several studies point to the psychological benefits of yoga as well when one is going through some health issue. Application of integrated yoga has been reported to result in better management of blood pressure, pulse rate, and state anxiety levels in patients with common neck pain.

However, there are no studies that have looked at disability, QOL, and anxiety measures after integrated yoga therapy involving loosening, strengthening, *Asanas*, etc. in patients with OA knees. Hence, the present study is planned to assess the effects of Integrated Approach of Yoga Therapy (IAYT) on QOL and anxiety in patients with OA knee. This will be done using generic health status tools by involving SF-36 and State Trait Anxiety Inventory (STAI).

## MATERIALS AND METHODS

Two hundred and fifty patients with OA knee joints from the orthopedics out-patient department were enrolled for the study. A sample size of 250 was obtained on G power software by fixing the alpha at 0.05, a power of 0.8, and an effect size of 0.379, considering the mean and Standard Deviation (SD) of an earlier study.<sup>[15]</sup> Two hundred and fifty patients of both genders with OA knee joints (one or both joints) satisfying the American College of Rheumatology (ACR) guidelines,<sup>[16]</sup> in the age group of 35–80 years were randomly assigned to the yoga group (age 59.56 ±8.18 years) or the control group (age 59.42 ±10.66 years). The study was approved by the Institutional Review Board (IRB) and the ethics committee of SVYASA University. Signed informed consent was obtained from all the participants.

### Inclusion criteria

- (i) Persistent pain for 3 months prior to participation in the study,
- (ii) Moderate to severe pain on walking,
- (iii) Kellegren and Lawrence<sup>[17]</sup> radiologic grading of II–IV in the X-rays taken within 6 months prior to entry,
- (iv) Those fully ambulant, literate, and willing to participate in the study.

### Exclusion criteria

- (i) Grade I changes in the X-ray,
- (ii) Acute knee pain,
- (iii) Secondary OA due to rheumatoid arthritis, gout, septic arthritis, tuberculosis, tumor, trauma, or hemophilia,
- (iv) Major medical or psychiatric disorders.

### Study Design

This was a prospective, randomized, parallel, active controlled study on patients with OA knee joints. After the initial screening for selection criteria, they were assigned to either yoga or control group. Out of 250 patients, 125

patients were assigned to each group. A computer-generated random number table was used for randomization. Numbered envelopes were used to conceal the sequence until the intervention was assigned. Both groups were given the conventional physiotherapy using Transcutaneous Electrical Stimulation (TENS) and ultrasound for 15 days. Both the groups had supervised practices at the center for 40 min daily (6 days/week) after physiotherapy (20 min) for 2 weeks. The study group was taught integrated yoga, and the control group was taught the non-yogic physiotherapy exercises by certified therapists. After this, they were asked to practice daily at home for the next 3 months. Compliance was supervised by telephonically once in 3 days, and a weekly review was conducted once a week for 3 months. The daily review cards were checked for the regularity, and doubts, if any, were clarified. All patients were asked to tick the practices daily after the home practice in the diary provided for the purpose. At every visit, their clinical progress and therapy received on the day were documented. All assessments were carried out on 1<sup>st</sup>, 15<sup>th</sup>, and 90<sup>th</sup> days.

### Blinding and masking

As this was an interventional study, double blinding was not possible. The answer sheets of the questionnaires were coded and analyzed only after the study was completed. The statistician who did the randomization and data analysis and the researcher who carried out the assessments were blinded to the treatment status of the subjects.

### Intervention for yoga group

The patients practiced Integrated Yoga at the center for 40 mins [Table 1] for 15 days after the conventional physiotherapy and later, they were advised to continue their practice at home for the next 3 months. Conventional physiotherapy was carried out only at the center for 15 days which included TENS - 10 mins and Ultrasound - 10 mins.

**Table 1: Yoga module for OA knees**

Sr. No.	Type of Exercise	Rounds	Duration (in min.)
A.	<b>ShithilikaranaVyayama (loosening exercises)</b>	--	10.0
1.	<b>Foot and ankle loosening practices</b>	--	3.0
	Passive rotation of each toe (clockwise and anticlockwise)	10	1.0
	Toe bending	10	0.5
	Passive rotation of ankle (clockwise and anticlockwise)	10	0.5
	Ankle bending (dorsiflexion and plantar flexion)	10	0.5
	Active ankle rotation (clockwise and anticlockwise)	10	0.5
2.	<b>Knee loosening practices</b>	--	2.5

	Bending the knee in prone position	--	1.0
	Knee bending – both sides	10	0.5
	Knee rotation – both sides	10	0.5
	Passive patella rotation (the patients made to do by themselves)	--	0.5
<b>3.</b>	<b>Hip and waist loosening practices</b>	--	1.5
	Half butterfly	10	0.5
	Full butterfly	10	0.5
	Hip rotations (both internal and external)	10	0.5
<b>4.</b>	<b>Upper limb loosening practices</b>	--	1.5
	Finger loosening	10	0.5
	Wrist loosening	10	0.5
	Wrist rotation (clockwise and anticlockwise)	10	0.5
<b>5.</b>	<b>Neck loosening practices</b>	--	1.5
	Forward and backward bending	10	1.0
	Neck rotation (both clockwise and anticlockwise)	10	0.5
<b>B.</b>	<b>IRT:</b> This is a 17-step relaxation technique done by contracting the muscles of the whole body, starting from the toes to the forehead, in a sequential manner and relaxing completely by letting go	--	2.0
<b>C.</b>	<b>Strengthening exercises (Sakti Vikaasaka Suksma Vyayama)</b>	--	5.0
	Back exercises ( <i>KatiSaktiVikaasaka</i> )	5	0.5
	Thigh exercises ( <i>JanghaSaktiVikaasaka</i> )	5	0.5
	Straight leg raise breathing – single and both legs	10	1.5
	Knee cap tightening – single and both legs	10	2.0
	Ankle tightening exercises	5	0.5
<b>D.</b>	<b>Quick Relaxation Technique (QRT):</b> This consists of three phases involving observing the abdominal movements, synchronizing them with breathing, and chanting of “A” kara	--	3.0
<b>E.</b>	<b>Yogasanas</b>	--	10.0
<b>a.</b>	Standing Asanas		
	<i>Tadasana</i>		
	<i>ArdhaKatiChakrasana</i>		
	<i>ArdhaChakrasana</i>		
	<i>PrasaritaPadahastasana</i>		
<b>b.</b>	Lying Asanas		
	<i>Bhujangasana</i>		
	<i>Shalabasana</i>		
	<i>ViparitaKarani</i>		
<b>F.</b>	<b>Deep Relaxation Technique (DRT)</b> This is a three-phase guided relaxation technique with relaxation from toes to the head, feeling of letting go, chanting OM, and feeling of limitless expansion through visualization	--	5.0
<b>G.</b>	<b>Nadishuddhi Pranayama</b> This is a slow rhythmic technique of alternate nostril breathing involving the phases of inhalation and exhalation using <i>Nasika Mudra</i> .	--	3.0
<b>H.</b>	<b>OM meditation:</b> This is done seated in any comfortable meditative posture repeating the syllable <i>OM</i> mentally	--	2.0

**Intervention for control group**

The patient did therapeutic practice at the center for 40 mins [Table 2] for 15 days after the conventional physiotherapy and later, they were advised to continue their practice at the home for the next 3 months. Conventional physiotherapy was carried out only at the center for 15 days which included TENS (why TENS in capital)- 10 mins and Ultrasound - 10 mins.

**Assessment criteria**

SF-36<sup>[48]</sup> was used to assess the QOL after the intervention in both groups on day 15 and day 90. Increase in scores indicates better QOL for the following domains: physical functioning, role of limitations in physical health, role of limitations in emotional problems, social functioning, pain reduction and general health. For the domains fatigue and emotional well-being, decrease in

**Table 2: Control module for OA knees**

S. No.	Type of Exercise	Rounds	Duration (in min.)
<b>A.</b>	<b>Loosening exercises</b>	--	10
<b>1.</b>	<b>Foot and ankle</b>	--	2.5
	Passive rotation of the toes (each toe clockwise and anticlockwise)	10	0.5
	Passive rotation of the ankle (both clockwise and anticlockwise)	10	0.5
	Toe bending	10	0.5
	Ankle bending	10	0.5
	Ankle rotation (clockwise and anticlockwise both sides)	10	0.5
<b>2.</b>	<b>Knee</b>	--	1.0
	Knee bending - both sides	10	0.5
	Knee rotation - both sides	10	0.5
<b>3.</b>	<b>Hip and waist loosening practices</b>	--	1.5
	Half butterfly	10	0.5
	Full butterfly	10	0.5
	Hip rotations (both internal and external)	10	0.5
<b>4.</b>	<b>Upper Limb loosening practices</b>	--	2.5
	Finger loosening	10	0.5
	Wrist loosening	10	0.5
	Wrist rotation (both clockwise and anticlockwise)	10	0.5
	Elbow loosening	5	0.5
	Arm loosening - forward and backward movements	10	0.5
<b>5.</b>	<b>Neck loosening practices</b>	--	2.0
	Forward and backward bending	10	0.5
	Sideward bending	10	0.5
	Sideward tilting	5	0.5
	Neck rotation (both clockwise and anticlockwise)	5	0.5
<b>B.</b>	<b>Quick pause</b>	--	2.0
<b>C.</b>	<b>Strengthening exercises</b>	--	5.0
	Palm exercises	5	0.5
	Elbow exercises	10	0.5
	Arm exercises	5	0.5
	Back exercises	5	0.5
	Thigh exercises	5	0.5
	Calf exercises	5	0.5
<b>D.</b>	<b>Rest</b>	--	3
<b>E.</b>	<b>Specific knee practices</b>	--	15.0
	Flexion and extension with and without resistance	--	3
	Knee cap tightening - self and against small pillow	--	3
	Straight leg raising - single and both - 30°/60°/90°	--	5
	Cycling	--	4
<b>F.</b>	<b>Supine rest</b>	--	5.0

scores indicates better QOL. The interconsistency of the SF-36 Health Survey Questionnaire as



determined by Cronbach's alpha was high and ranged from 0.72 to 0.94.

A high degree of internal consistency for STAI, with Cronbach's alpha of 0.38–0.89 for each of the 40 items and 0.86 for the total scores was reported.<sup>[19]</sup> Test–retest correlation coefficients for 40 items were highly significant. Intra-class correlation coefficient (ICC) was also high (0.39–0.89).

### Statistical analysis

The data were analyzed using SPSS Version 16. The baseline value of the two groups were checked for normal distribution by Shapiro–Wilk test. Baseline matching was checked by Mann–

Whitney test. Wilcoxon's signed ranks test and Mann–Whitney U test were used for assessing within- and between-groups differences, respectively.

### OBSERVATIONS AND RESULTS

In present study 250 patients were registered and randomly divided into two groups. In yoga group 118 patients and in control group 117 completed the treatment. The baseline characteristics was similar between both the groups with regard to all the variables ( $P > 0.05$ , Mann–Whitney test for pre values). The same is depicted in Table 3.

Sr. No.	Characteristics	Yoga Group (n = 125)	Control Group (n = 125)
1.	Age in years (Mean ± SD)	59.56 ± 8.18	59.42 ± 10.66
2.	Sex	Males	37
		Females	88
3.	Occupation	Skilled workers	28
		Semi-skilled workers	34
		Unskilled workers	3
		Others	60
4.	Duration of the disease	<1 year	62
		1–2 years	39
		>2 years	24
5.	Associated diseases	Diabetes	22
		Hypertension	30
		Overweight/obesity	98
		Osteoporosis	78
		Others	26

Table 4 shows the results obtained in the yoga group on day 15 and day 90. Table 5 shows the results obtained in the control group on day 15 and day 90, and Table 6 shows the comparison of results between the yoga and the control groups.

Sr. No.	Parameters	Assessment period	Mean ± SD	95% CI		P- value
				LB	UB	
1.	Physical functioning	Pre	12.03 ± 9.94	10.2215	13.8463	--
		Po 1	39.32 ± 11.24	37.2718	41.3722	<0.001
		Po 2	67.50 ± 9.09	65.8410	69.1590	<0.001
2.	Role limitation in physical health	Pre				--
		Po 1	52.33 ± 29.59	46.9347	57.7263	<0.001
		Po 2	86.44 ± 16.55	83.4230	89.4584	<0.001
3.	Emotional problems	Pre				--
		Po 1	56.17 ± 22.93	51.9892	60.3532	<0.001
		Po 2	86.41 ± 17.59	83.2081	89.6224	<0.001
4.	Energy/fatigue	Pre	66.36 ± 5.66	65.3307	67.3981	--
		Po 1	50.10 ± 6.30	48.9560	51.2559	<0.001
		Po 2	36.35 ± 6.08	35.2464	37.4654	<0.001
5.	Emotional well-being	Pre	63.10 ± 7.17	61.7939	64.4095	--
		Po 1	48.88 ± 7.01	47.6017	50.1610	<0.001

6.	Social functioning	Po 2	34.33 ± 5.46	33.3420	35.3359	<0.001
		Pre	50.50 ± 6.82	49.2648	51.7522	--
		Po 1	57.83 ± 6.89	56.5820	59.0959	<0.001
7.	Pain	Po 2	64.04 ± 8.92	62.4202	65.6731	<0.001
		Pre	11.54 ± 11.55	9.4398	13.6534	--
		Po 1	47.88 ± 11.33	45.8139	49.9488	<0.001
8.	General health	Po 2	73.77 ± 12.67	71.4596	76.0828	<0.001
		Pre	36.91 ± 6.94	35.6459	38.1795	--
		Po 1	59.31 ± 12.24	57.0803	61.5451	<0.001
9.	STAI-1	Po 2	77.47 ± 20.91	73.6644	81.2898	<0.001
		Pre	62.39 ± 6.82	61.15	63.63	--
		Po 1	40.19 ± 4.49	39.37	41.01	<0.001
10.	STAI-2	Po 2	25.96 ± 4.80	25.08	26.83	<0.001
		Pre	62.20 ± 6.07	61.03	63.04	--
		Po 1	40.63 ± 4.54	40.01	41.49	<0.001
		Po 2	26.68 ± 5.71	26.14	26.96	<0.001

Po 1: Post day 15, Po 2: Post day 90, SD: Standard deviation, CI: Confidence interval, LB: Lower bound, UB: Upper bound, STAI-1: State trait anxiety inventory 1, STAI-2: State trait anxiety inventory 2

**Table 5: Effect of control intervention in OA patients**

Sr. No.	Parameters	Assessment period	Mean ± SD	95% CI		P- value
				LB	UB	
1.	Physical functioning	Pre	12.82 ± 10.81	10.8401	14.8009	--
		Po 1	24.95 ± 13.93	22.4057	27.5089	<0.001
		Po 2	50.94 ± 14.76	48.2361	53.6442	<0.001
2.	Role limitation in physical health	Pre	0.21 ± 2.31	-0.2095	0.6369	--
		Po 1	35.47 ± 36.14	28.8516	42.0886	<0.001
		Po 2	58.33 ± 44.52	50.1798	66.4868	<0.001
3.	Emotional problems	Pre	0.56 ± 6.15	-0.5582	1.6967	--
		Po 1	31.02 ± 26.86	26.1063	35.9433	<0.001
		Po 2	58.75 ± 38.94	51.6221	65.8839	<0.001
4.	Energy/fatigue	Pre	64.91 ± 5.41	63.9233	65.9057	--
		Po 1	58.97 ± 5.63	57.9434	60.0053	<0.001
		Po 2	53.20 ± 6.86	51.9474	54.4629	<0.001
5.	Emotional well-being	Pre	62.46 ± 6.61	61.2494	63.6737	--
		Po 1	57.43 ± 5.78	56.3760	58.4958	<0.001
		Po 2	52.27 ± 5.91	51.1909	53.3562	<0.001
6.	Social functioning	Pre	51.92 ± 9.37	50.2067	53.6395	--
		Po 1	52.67 ± 9.40	50.9489	54.3929	<0.001
		Po 2	57.15 ± 10.42	55.2498	59.0664	<0.001
7.	Pain	Pre	11.68 ± 9.11	10.0181	13.3580	--
		Po 1	30.21 ± 9.99	28.3831	32.0425	<0.001
		Po 2	46.93 ± 11.22	44.8786	48.9881	<0.001
8.	General health	Pre	36.99 ± 11.08	34.9652	39.0263	--
		Po 1	48.75 ± 9.26	47.0642	50.4555	<0.001
		Po 2	60.12 ± 12.57	57.8180	62.4230	<0.001
9.	STAI-1	Pre	62.37 ± 8.93	60.73	64.00	--
		Po 1	52.62 ± 8.70	51.02	54.21	<0.001
		Po 2	38.17 ± 5.88	37.09	39.25	<0.001
10.	STAI-2	Pre	60.17 ± 9.35	59.78	63.00	--
		Po 1	51.67 ± 8.19	50.01	52.21	<0.001
		Po 2	39.27 ± 5.88	38.09	38.25	<0.001

Po 1: Post day 15, Po 2: Post day 90, SD: Standard deviation, CI: Confidence interval, LB: Lower bound, UB: Upper bound, STAI-1: State trait anxiety inventory 1, STAI-2: State trait anxiety inventory 2

**Table 6: Comparison between the groups**

Sr. No.	Parameters	Assessment period	ES	P- value
1.	Physical functioning	Po 1	1.13	<0.001
		Po 2	1.35	<0.001
2.	Role limitation in physical health	Po 1	0.51	<0.001
		Po 2	0.84	<0.001
3.	Emotional problems	Po 1	1.01	<0.001
		Po 2	1.11	<0.001
4.	Energy/fatigue	Po 1	1.48	<0.001
		Po 2	2.60	<0.001
5.	Emotional well-being	Po 1	1.33	<0.001
		Po 2	3.15	<0.001
6.	Social functioning	Po 1	0.63	<0.001
		Po 2	0.71	<0.001
7.	Pain	Po 1	1.65	<0.001
		Po 2	2.24	<0.001
8.	General health	Po 1	0.97	0.001
		Po 2	1.01	0.001
9.	STAI-1	Po 1	1.79	<0.001
		Po 2	2.28	<0.001
10.	STAI-2	Po 1	1.72	<0.001
		Po 2	2.01	<0.001

Po 1: Post day 15, Po 2: Post day 90, STAI-1: State trait anxiety inventory 1, STAI-2: State trait anxiety inventory 2, and ES, Effect size

### Quality of life

Between- and within-group differences were highly significant ( $P < 0.001$ ) on all domains of SF-36 with better improvement in the yoga group than in the control group on day 15 and day 90. In the yoga group, the physical function increased from  $12.03 \pm 9.94$  to  $39.32 \pm 11.24$  and further to  $67.50 \pm 9.09$ , and in the control group from  $12.82 \pm 10.81$  to  $24.95 \pm 13.93$  and further to  $50.94 \pm 14.76$  on day 15 and day 90, respectively. The result shows better improvement in the limitations of physical health of the yoga group (scores improved from  $52.33 \pm 29.59$  to  $86.44 \pm 15.55$ ) compared to limitations of the physical health of the control group (scores improved from  $35.47 \pm 36.14$  to  $58.33 \pm 44.52$ ) on day 15 and day 90 respectively. Better improvement in the limitations of emotional health of the yoga group (scores improved from  $56.17 \pm 22.93$  to  $86.41 \pm 17.59$ ) compared to limitations of the emotional health of the control group (scores improved from  $31.02 \pm 26.86$  to  $58.75 \pm 38.94$ ) on day 15 and day 90 respectively. The energy and fatigue level improved in both groups, with reduction of scores from  $66.36 \pm 5.66$  to  $50.10 \pm 6.30$  and further to  $36.35 \pm 6.08$  in the yoga group and from  $64.91 \pm 5.41$  to  $58.97 \pm 5.6$  and further to  $53.20 \pm 6.8$  in the control group on day 15 and day 90, respectively,

with significantly better results in the yoga group than in the control group. In the yoga group, the emotional well-being improved with reduction in scores from  $63.10 \pm 7.17$  to  $48.88 \pm 7.01$  and further to  $34.33 \pm 5.46$ , and in the control group, the reduction in scores was from  $62.46 \pm 6.61$  to  $57.43 \pm 5.78$  and further to  $52.27 \pm 5.91$  on day 15 and day 90, respectively, with significantly better results in the yoga group than in the control group. In the yoga group, the social functioning increased from  $50.50 \pm 6.82$  to  $57.83 \pm 6.89$  and then to  $64.04 \pm 8.92$ , and in the control group, it increased from  $51.92 \pm 9.37$  to  $52.67 \pm 9.40$  and further to  $57.15 \pm 10.42$  on day 15 and day 90, respectively, with significantly better results in the yoga group than in the control group. Well-being on scores of pain improved in both groups, with the increase from  $11.54 \pm 11.55$  to  $47.88 \pm 11.33$  and further to  $73.77 \pm 12.67$  in the yoga group and from  $11.68 \pm 9.11$  to  $30.21 \pm 9.09$  and then to  $46.93 \pm 11.22$  in the control group on day 15 and day 90, respectively, with significantly better results in the yoga group than in the control group. The general health increased in both groups. It increased from  $36.91 \pm 6.94$  to  $59.31 \pm 12.24$  and further to  $77.47 \pm 20.91$  in the yoga group and from  $36.99 \pm 11.08$  to  $48.75 \pm 9.26$  and then to  $60.12 \pm 12.57$  in the control group on day 15 and day 90, respectively,

with significantly better results in the yoga group than control group [Table 3-5].

### State and trait anxiety scores

Even state and trait anxiety scores ( $p < 0.001$ ) also showed decent improvement within the group and between the groups when checked at the 2<sup>nd</sup> week and the 3<sup>rd</sup> month.

### DISCUSSION

This randomized, two-armed, parallel, controlled trial on 250 participants included patients of both genders ( $F = 175$ ) with OA of knees and aged between 35 and 80 years. Yoga group showed significantly better result compared to the control group on all the variables ( $P < 0.001$ ) of SF - 36. Results showed significantly better improvement in the yoga than in the control group for all variables ( $P < 0.001$ ) of SF-36.

### Pain reduction

Assessment of the patients at week 6 revealed a statistically significant improvement in pain and disability scores of the Western Ontario and MacMaster Universities (WOMAC) questionnaire and EuroQol score in the active treatment group.<sup>[20]</sup> The reduction in pain observed in our study points to the beneficial effect of yoga as an add-on therapy to the conventional physiotherapy practices. In our study, we included yoga after the standard physiotherapy and the degree of changes appears to be similar in all the three yoga studies (37-47%). This may point to the efficacy of yoga when used with or without a session of physiotherapy before the practice of yoga. Studies found increased SF-36 physical function, physical role, social and mental health scores, and physical performance scores. It also showed decrease in the WOMAC pain after a 4-month strength exercise program.<sup>[21]</sup>

### State trait anxiety

In our earlier study on patients with chronic neck pain,<sup>[14]</sup> we had observed significant (19.3%) reduction in STAI-1 scores as compared to 8.2% in the control group within 10 days of intervention. In the present study, we used both state and trait anxiety measures, as this was a long-term study with a follow-up program of 3 months. The reduction in anxiety scores after yoga in both STAI-1 (post 1- 36% and post 2- 58%) and STAI-2 (post 1- 35% and post 2- 57%) was much higher in these patients with chronic knee pain as compared to those with neck pain.

The present study has revealed a statistically significant improvement in respect of all the domains of the SF-36 and STAI.

### Mechanisms

Several factors would have contributed to the beneficial effects observed in both the groups during this study. As noted in several earlier studies, physiotherapy intervention may increase the blood flow. Better results in the yoga group could be due to the effect of *Yogasanas*, *Pranayama*, relaxation, and its stress-reducing effect, since yoga is meant to bring both physical and emotional stability.

### Strengths of the study

Good sample size, randomized control design, active supervised intervention for the control group for the same duration as the experimental group, and follow-up for 3 months with good compliance are the strengths of this study. The result of this study that has shown marked differences between groups in all variables offers strong evidence for incorporating this module of IAYT for knees by the clinicians.

### Suggestions for future work

A longer follow up of  $\geq 12$  months is necessary to check for long-term efficacy and long-term acceptability. Studies using Magnetic Resonance Imaging (MRI) and biochemical variables may throw light on the mechanisms.

### CONCLUSION

Adjunctive program of IAYT for OA knee joints improves all components of QOL on SF-36 and reduces anxiety. IAYT offers a good value addition as a non-pharmacological intervention in improving QOL and in reducing the anxiety in patients with OA knee joints.

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**Cite this article as:**

John Ebnezar, Yogitha J. Ebnezar. Effect of Yoga Therapy on Quality of life and Anxiety in Osteoarthritis of the Knee Joint. *Int. J. Ayur. Pharma Research*. 2014;2(8):40-48.

**Source of support: Nil, Conflict of interest: None Declared**

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