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Original Article

Integrating Physio-Yogic Exercises for Rotator Cuff Tendinopathy in Indian Overhead Athletes: A Comprehensive Approach

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Background: Athletes affected by rotator cuff tendinopathy experience discomfort, stiffness, reduced range of motion, diminished athletic performance, and decreased quality of life. This study aimed to determine the efficacy of physio-yogic exercises in reducing pain and disability, increasing range of motion, and improving quality of life in Indian overhead athletes with rotator cuff tendinopathy.

Methods: Sample from 45 athletes was divided into three groups: scapular recruitment exercises, physio-yogic exercises, and yoga asanas. Pre-intervention readings of the Shoulder Pain and Disability Index (SPADI), Athlete Quality of Life Scale (ALQS), and Shoulder Active Range of Motion (AROM) were taken at day 1 and post-intervention readings were taken at the end of week 8. The paired Student's t-test was used to compare the values of the outcome measures for the preintervention and postintervention within the groups. Analysis of variance was used to compare the mean values of change in the outcome measures from preintervention to postintervention between the groups. Post hoc test was conducted to compare the postintervention values of the outcome measures between the groups.

Results: Total scores of SPADI ($p < 0.0001$), ALQS ($p < 0.0001$), and Shoulder AROM ($p < 0.0001$) demonstrated statistically significant improvements in the physio-yogic exercise group.

Conclusion: The physio-yogic exercise protocol for rotator cuff tendinopathy is a unique regimen that combines the positive effects of yoga asanas and the advantages of scapular recruitment exercises. Thus, the physio-yogic exercise protocol can further promote the rehabilitation program for rotator cuff tendinopathy.

Keywords: Athletic injuries, Exercise therapy, Rotator cuff injuries, Shoulder pain, Tendinopathy, Yoga

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INTRODUCTION

Rotator cuff tendinopathy encompasses a range of shoulder conditions, including rotator cuff tendinitis/tendinosis, shoulder impingement syndrome and subacromial bursitis [1]. Shoulder injuries are present in 30% of overhead athletes of which 27% are Subacromial Impingement Syndrome and 24% are Rotator Cuff Tendonitis [2]. Overhead athletes are more prone to sustaining rotator cuff tendinopathy owing to the demands of the sports, thereby affecting their performance and their athletic pursuits [3]. The pathogenesis of rotator cuff tendinopathy is attributed to a combination of factors characterized by multifactorial etiology involving failed healing process [4].

The management of rotator cuff injuries is determined by the specific type of injury and its severity [5]. The primary approach to address the deficits of the rotator cuff muscles and restore the shoulder function which is directed towards conservative approach [6]. In the past few years, several studies [7-9] have reported the efficacy of scapular stabilisation exercise, however, there is lack of consensus regarding the evidence supporting the effectiveness of specific exercises techniques in clinical practice. Recent literature recommends the need of implementing targeted exercise program to enhance scapular kinematics, muscle activity, strength, flexibility and overall function of the shoulder during the rehabilitation process [10].

Overhead throwing specifically involves a dynamic, full-body motion that demands a combination of strength, flexibility, functional stability, flexibility and precise neuromuscular coordination [11]. Research suggests that history of stressors and the associated stress response had strong correlation with the rate of injury [12], therefore, the incorporation of psychological intervention should be considered in both injury prevention and during the rehabilitation process. Originating in India, yoga is one such ancient movement practice of mindfulness that seeks to bring balance to various dimensions of wellness [13].

In recent times, yoga is increasingly acknowledged as a structured training program that enhances physical fitness parameters, including flexibility, strength and optimizing sports performance [11]. An increasing body of evidence suggests that yoga asanas improve health across different population by modulating the sympathetic nervous system and the hypothalamic-pituitary-adrenal system [14]. Subsequently, yoga has a positive impact on the Quality of Life (QOL), promoting positive enhancements in various aspects of well-being [15]. Nevertheless, there are conflicting views regarding the efficacy of yoga, creating a diversity of perspective within the research community. Consequently, this study aimed to assess the effectiveness of physio-yogic exercises and scapular activation exercises in reduction of pain and disability, increase in range of motion and improvement in QOL in Indian overhead athletes with Rotator Cuff Tendinopathy.

MATERIALS AND METHODS

The study was conducted as a randomized controlled trial at Amity Institute of Health Allied Sciences, Amity University, Noida, and Dr. Vimal's Physiotherapy and Sports Injury Clinic, Delhi, between February 2023 and July 2023. This population-based experimental study followed the Helsinki Declaration. It was approved by the Institutional Ethics Committee (Ref: NTCC/MPT- Sports Medicine /23-24/ Jan 23/11) and registered with the Clinical Trial Registry of India (CTRI Reg: CTRI/2023/01/048954).

The study enlisted overhead athletes (ages 17-35) diagnosed with Rotator Cuff Tendinopathy, demonstrating positive Neer's, Hawkin's, and Jobe's tests. It excluded those with spinal-related discomfort, prior/current shoulder dislocations or surgeries, steroid injections in the past year, physiotherapy, or use of non-steroidal anti-inflammatory drugs. Athletes provided informed consent and demographic details (age, gender, sport). A sample size of 45 was calculated using G*Power Version 3.1.9.4. The CONSORT diagram (Fig. 1) represents the experimental protocol of this study.

Athletes with rotator cuff tendinopathy were randomly assigned to three groups: Yoga Asana, Physio-Yogic, and Scapular Recruitment. A neutral third party created a random allocation list to determine group assignments. Sealed envelopes with numbered allocations were opened by an unbiased investigator after initial assessments to maintain participant blinding. The athletes underwent eight-week intervention programs, and their performance on outcome tests for Shoulder Active Range of Motion (AROM) using goniometer [16], Shoulder Pain and Disability Index (SPADI) [17], and Athlete Life Quality Scale (ALQS) [18] was assessed both before and after the intervention.

1. Scapular recruitment exercise protocol

Fifteen athletes in the Scapular Recruitment group did an 8-week scapular recruitment protocol with exercises proven to activate scapular muscles. They did three sessions per week, with each session consisting of 3 sets of 10 repetitions [19]. Exercises were carried out using dumbbells and Thera-Bands, progressing from yellow to red to green to blue. Progression of resistance increased on a bi-weekly basis as per fatigue level. The exercise range comprised Shoulder Shrugging, 90° Abduction & External Rotation, Prone Overhead Raise, Prone Unilateral Row, 90° Abduction in Scaption Plane, Prone External Rotation (ER) with 90° of Abduction

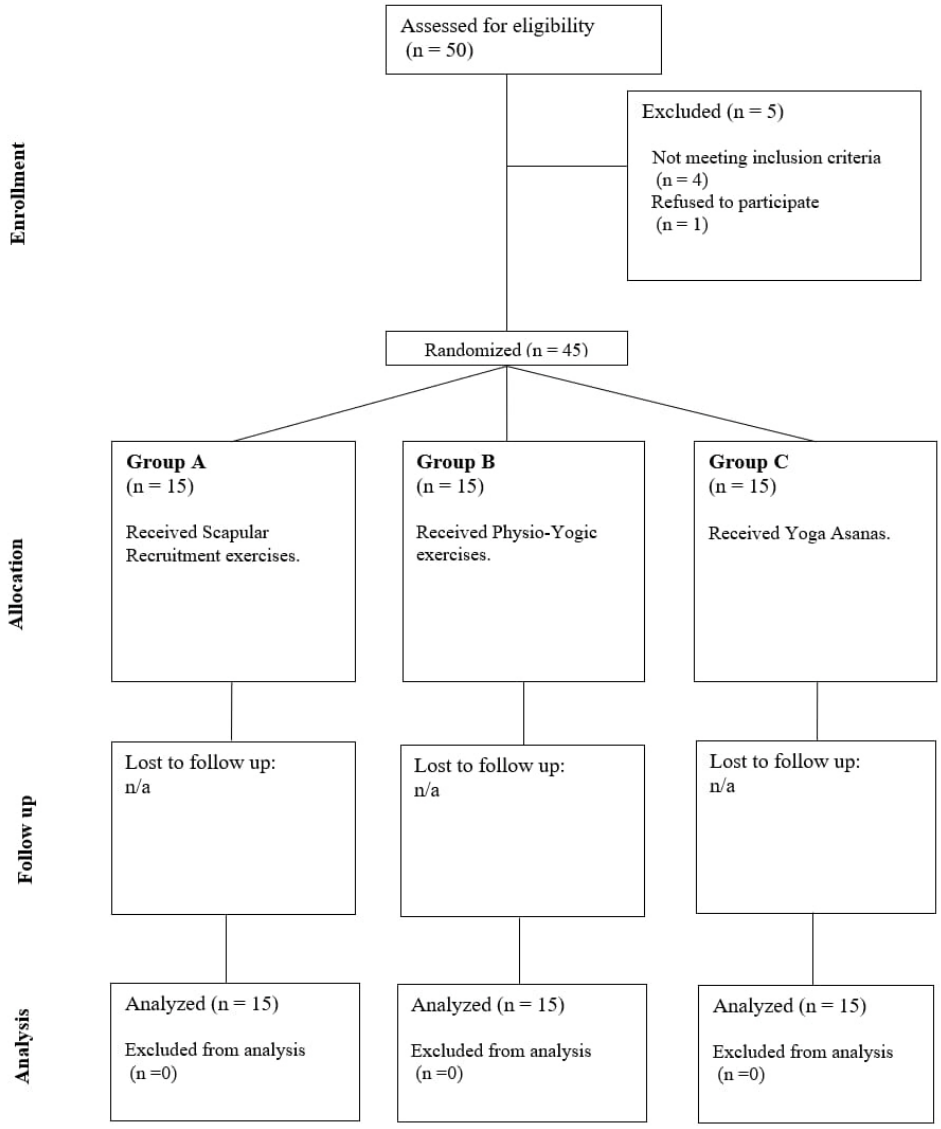

Fig. 1. The study protocol according to the CONSORT diagram model.

and 90° of Elbow Flexion, ER in Side Lying with 90° of Elbow Flexion and Supine Press with Dumbbells [20].

2. Physio-yogic exercise protocol

This group underwent an exercise protocol that consisted of scapular muscle activation exercises and shoulder-focused yoga asanas. Participants performed one set of three repetitions with an 8-second hold after each repetition for yoga asanas, and for scapular recruitment exercises, they completed three sets of ten repetitions [19]. The same exercise protocol as that of the scapular recruitment exercise group was implemented in this group. Yoga asanas consisted of the following: Hasttotanasana (Raised Arms Pose), Tadasana (Mountain Pose), Adhomukha Swanaasana (Downward Facing Dog Pose), Urdhvamukho Swanaasana (Upward Facing Dog Pose), Dandasana (Modified Plank Pose), Uttanmandukasana (Extended Frog Pose), and Yogamudrasana (Yoga Seal Pose).

3. Yogic asana protocol

Fifteen overhead athletes in this group received an eight-week yoga treatment targeting the entire shoulder joint, involving three weekly sessions, each consisting of one set of three repetitions with an 8-second hold for each yoga asana. The asana range comprised Purovottanasana (Upward Plank Pose), Paschimottanasana (Seated Forward Bend Pose), Hasttotanasana, Tadasana, Tiryak Tadasana (Oblique Palm Tree Pose), Adhomukha Swanaasana, Urdhvamukho Swanaasana, Dandasana, Uttanmandukasana, Yogamudrasana, and Shashakasana (Rabbit Pose).

4. Statistical analysis

Statistical analysis was conducted using IBM SPSS Sta-

tistics 24.0 (IBM Co.), involving 45 participants whose demographics and outcome measures were examined. Quantitative data were summarized with means and standard deviations, while categorical data were presented as absolute numbers and percentages. Range of motion was measured in degrees, with readings taken at week 0 (pre-intervention) and week 8 (post-intervention). Paired Student t-tests compared pre- and post-intervention values within three groups: Scapular Recruitment Exercises, Physio-Yogic Exercises, and Yoga Asanas. An interaction effect was assessed at a 5% significance level. ANOVA compared changes in outcome measures from pre- to post-intervention and pre-intervention means among the three groups. Post Hoc Test (Bonferroni's Test) was used to compare post-intervention means across these groups.

RESULTS

This study assessed Physio-Yogic exercises for Indian overhead athletes with Rotator Cuff Tendinopathy. Among 50 approached athletes, 45 (mean age: 23.3±3.5 years) were divided into three groups: Scapular Recruitment Exercises (15 athletes), Physio-Yogic Exercises (15 athletes), and Yoga Asanas (15 athletes).

Of the 45 athletes, 25 were male and 2 were females. The athletes represented various sports, with badminton (35.6%), bowlers (17.8%), volleyball (15.6%), and basketball (13.3%) being the most common, while others included swimmers, tennis players, and shot-putters (Table 1).

When comparing SPADI and ALQS scores along with AROM values across all three groups, a Paired t-test demonstrated statistically significant improvement. In the Physio-Yogic Exercise Group, the mean Total SPADI score decreased from 50.4±19.0 to 7.9±5.0, ALQS score increased

Table 1. Demographic details

Demographics		Number of athletes	Percentage of athletes (%)
Sex	Male	25	55.6
	Female	20	44.4
Age distribution (yr)	Mean age	23.3 ± 3.5[a] (17.0-31.0)	-
	Median age	23.0 (22.0-25.0)	-
Sport played	Badminton	16	35.6
	Cricket (bowlers)	8	17.8
	Volleyball	7	15.6
	Basketball	6	13.3
	Swimming	4	8.9
	Tennis	3	6.7
	Shotput	1	2.2

[a]Values are presented as mean±standard deviation.

Table 2. Within-group (pre-post comparison) of all groups (paired t-test)

Variables & groups		Scapular recruitment					Physio-Yoga					Yoga				
		Week 0	Week 8	Δ[a]	t-value	p-value	Week 0	Week 8	Δ	t-value	p-value	Week 0	Week 8	Δ	t-value	p-value
Shoulder pain and disability index (SPADI)	SPADI pain	47.1 ± 22.9	12.0 ± 6.9	35.1 ± 6.6	5.275	<0.0001[b]	52.9 ± 17.1	7.1 ± 5.0	45.9 ± 4.3	10.589	<0.0001[b]	43.7 ± 11.9	20.7 ± 7.5	23.1 ± 2.0	11.767	<0.0001[b]
	SPADI disability	39.8 ± 26.6	11.1 ± 6.3	28.7 ± 7.3	3.917	0.002[b]	48.8 ± 21.3	8.4 ± 5.5	40.3 ± 5.1	7.88	<0.0001[b]	39.2 ± 13.8	17.6 ± 6.7	21.6 ± 2.2	9.733	<0.0001[b]
	Total SPADI	42.6 ± 24.4	11.4 ± 6.2	31.1 ± 6.9	4.534	<0.0001[b]	50.4 ± 19.0	7.9 ± 5.0	42.5 ± 4.6	9.284	<0.0001[b]	40.9 ± 11.7	18.8 ± 5.9	22.2 ± 1.9	11.831	<0.0001[b]
Athlete life quality scale (ALQS)	ALQS	61.5 ± 19.4	71.1 ± 14.9	-9.6 ± 1.5	-6.379	<0.0001[b]	68.3 ± 12.1	82.2 ± 9.9	-13.9 ± 1.4	-10.034	<0.0001[b]	60.5 ± 10.1	71.1 ± 9.6	-10.7 ± 1.8	-5.984	<0.0001[b]
Shoulder active range of motion	Flexion	168.9 ± 5.1	178.5 ± 2.2	-9.6 ± 1.3	-7.549	<0.0001[b]	168.5 ± 4.5	178.6 ± 1.7	-10.1 ± 1.3	-7.92	<0.0001[b]	168.0 ± 4.1	178.3 ± 1.5	-10.3 ± 1.2	-8.773	<0.0001[b]
	Extension	50.6 ± 4.1	53.1 ± 3.0	-2.5 ± 0.7	-3.476	0.004[b]	49.1 ± 3.5	53.5 ± 3.0	-4.4 ± 1.0	-4.363	0.001[b]	49.8 ± 3.1	53.1 ± 3.0	-3.3 ± 1.0	-3.244	0.006[b]
	Abduction	93.5 ± 10.9	178.6 ± 1.7	-85.1 ± 2.9	-29.326	<0.0001[b]	92.8 ± 10.4	178.7 ± 1.5	-85.9 ± 2.8	-31.241	<0.0001[b]	93.0 ± 9.0	178.9 ± 1.3	-85.9 ± 2.3	-37.12	<0.0001[b]
	External rotation	44.8 ± 7.5	87.9 ± 1.8	-43.1 ± 2.0	-21.782	<0.0001[b]	44.4 ± 7.9	88.0 ± 1.4	-43.6 ± 2.2	-20.004	<0.0001[b]	44.6 ± 6.2	88.3 ± 1.3	-43.7 ± 1.7	-25.145	<0.0001[b]
	Internal rotation	53.3 ± 7.3	79.9 ± 2.8	-26.6 ± 2.2	-12.156	<0.0001[b]	53.1 ± 6.1	80.2 ± 2.6	-27.1 ± 1.6	-16.74	<0.0001[b]	53.1 ± 5.7	80.1 ± 2.2	-26.9 ± 1.7	-16.249	<0.0001[b]

Values are presented as mean±standard deviation.
[a]Mean difference.
[b]Statistically significant.

from 68.3±12.1 to 82.2±9.9, Extension AROM increased from 49.1±3.5 to 53.5±3.0, Abduction AROM increased from 92.8±10.4 to 178.7±1.5, ER AROM increased from 44.4±7.9 to 88.0±1.4, and Internal Rotation AROM increased from 53.1±6.1 to 80.2±2.6. The Yoga Asana Group showed statistically significant improvement in Flexion AROM, increasing from 168.5±4.5 to 178.6±1.7 (Table 2).

When comparing the mean changes in SPADI and ALQS scores, as well as AROM values among the three groups, ANOVA testing revealed significant differences. Specifically, the Physio-Yogic Exercise Group exhibited a substantial reduction in the mean Total SPADI score (42.5±4.6) ($F = 4.343$; $p = 0.019$), while the Yoga Asana Group demonstrated significant improvements in mean Flexion AROM values (–10.3±1.2) (Table 3).

Post Hoc analysis revealed significant improvements in various measures. Specifically, in the Physio-Yogic Exercises group compared to the Scapular Recruitment Exercises group, there was significant improvement in ALQS ($p = 0.043$). Additionally, in comparison with the Yoga Exercises group, the Physio-Yogic Exercises group showed significant improvement in SPADI Pain Score ($p < 0.0001$), SPADI disability scores ($p = 0.002$), and Total SPADI scores ($p < 0.0001$) (Table 4). Post Hoc analysis of AROM showed no statistically significant difference between the three groups (Table 5).

DISCUSSION

Yoga has been extensively documented to offer a wide range of benefits, encompassing notable improvement in mental and physical health, reduced stress levels and overall improvement in QOL [21]. With the flight-or-fight stress reaction being interrupted by yoga practice, a condition physiologically opposed to that of the stress response can be attained, leading to a sense of harmony and connection between the mind and body [22]. The results from the current study showed that compared to Scapular Recruitment Exercises and Yoga Asanas, the Physio-Yogic Exercise program was able to better enhance shoulder range of motion together with improvements in pain & disability and QOL as measured by SPADI and ALQS respectively.

The practice of yoga improves the overall QOL and with the increase in contemplative practices, yoga has started to be included as part of athletes rehabilitation process [23,24]. It aims to cultivate inner tranquillity, promoting a sense of well-being, relaxation, self-confidence, improved efficiency, increased attentiveness, reduced irritability, and a positive perspective on life [25]. In addition, yoga inhibits the posterior or sympathetic area of the hypothalamus, optimizing the body's response to stress and restoring autonomic regulatory reflex mechanisms. This inhibition lowers anxiety levels, heart rate, respiratory rate, blood pressure, and cardiac output in students engaged in yoga and meditation [26,27].

Regular yoga practice gradually releases tension in the muscles and connective tissues surrounding the joints, thereby improving the range of motion. Through the comprehensive movements in yoga, the joint and its surrounding structures receive nourishment and increased circulation, contributing to reduced discomfort and pain [28]. Yoga's multifaceted approach, yoga serves as a structured activity that replicates essential elements of athletic performance, such as balance, flexibility, coordination, muscular strength and endurance [29,30].

Scapular Recruitment exercises stabilize the humeral head in the glenoid fossa while preserving the space between the greater tubercle and acromion, effectively preventing potential compression of structures in that region [10]. Optimal function of scapular muscles is necessary for function of rotator cuff, therefore, to unload the rotator cuff tendon, exercises are directed towards regaining scapular mechanics and neuromuscular control further enhancing proximal stability [31,32].

The combination of yoga asanas and scapular recruitment exercises offers a beneficial and effective approach in

Table 3. Comparison of mean improvement between all groups (ANOVA)

Variables & groups		Scapular recruitment	Physio-yoga	Yoga	F-value	p-value
Shoulder Pain And Disability Index (SPADI)	SPADI pain	35.1 ± 6.6	45.9 ± 4.3	23.1 ± 2.0	5.843	0.006[a]
	SPADI disability	28.7 ± 7.3	40.3 ± 5.1	21.6 ± 2.2	3.176	0.052
	Total SPADI	31.1 ± 6.9	42.5 ± 4.6	22.2 ± 1.9	4.343	0.019[a]
Athlete Life Quality Scale (ALQS)	ALQS	–9.6 ± 1.5	–13.9 ± 1.4	–10.7 ± 1.8	2.075	0.138
Shoulder Active Range of Motion	Flexion	–9.6 ± 1.3	–10.1 ± 1.3	–10.3 ± 1.2	0.093	0.911
	Extension	–2.5 ± 0.7	–4.4 ± 1.0	–3.3 ± 1.0	1.117	0.337
	Abduction	–85.1 ± 2.9	–85.9 ± 2.8	–85.9 ± 2.3	0.033	0.968
	External rotation	–43.1 ± 2.0	–43.6 ± 2.2	–43.7 ± 1.7	0.028	0.973
	Internal rotation	–26.6 ± 2.2	–27.1 ± 1.6	–26.9 ± 1.7	0.021	0.979

Values are presented as mean±standard deviation.
[a]Statistically significant.

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Table 4. SPADI & ALQS post hoc analysis of all groups

Variables & groups	SPADI pain				SPADI disability				Total SPADI				ALQS			
	Mean	Δ[a)]	t-value	p-value	Mean	Δ	t-value	p-value	Mean	Δ	t-value	p-value	Mean	Δ	t-value	p-value
Scapular recruitment	–35.1 ± 25.7	-	-	-	–28.7 ± 28.3	-	-	-	–31.1 ± 26.6	-	-	-	9.6 ± 5.8	-	-	-
Physio-yoga	–45.9 ± 16.8	10.8 ± 7.9	1.361	0.184	–40.3 ± 19.8	11.7 ± 8.9	1.306	0.202	–42.5 ± 17.7	11.3 ± 8.2	1.374	0.180	13.9 ± 5.4	–4.3 ± 2.0	–2.116	0.043[b)]
Yoga	–23.1 ± 7.6	12.0 ± 6.9	1.732	0.094	–21.6 ± 8.6	7.1 ± 7.6	0.926	0.362	–22.2 ± 7.3	9.0 ± 7.1	1.261	0.218	10.7 ± 6.9	1.1 ± 2.3	0.457	0.651
Post hoc analysis of SPADI and ALQS for physio-yoga and yoga group																
Physio-yoga	–45.9 ± 16.8	-	-	-	–40.3 ± 19.8	-	-	-	–42.5 ± 17.7	-	-	-	13.9 ± 5.4	-	-	-
Yoga	–23.1 ± 7.6	22.8 ± 4.8	4.796	<0.0001[b)]	–21.6 ± 8.6	18.8 ± 5.6	3.361	0.002[b)]	–22.2 ± 7.3	20.3 ± 4.9	4.109	<0.0001[b)]	10.7 ± 6.9	–3.3 ± 2.3	–1.446	0.159

Values are presented as mean±standard deviation.
SPADI: Shoulder Pain And Disability Index, ALQS: Athlete Life Quality Scale.
[a)]Mean difference.
[b)]Statistically significant.

Table 5. Shoulder active range of motion post hoc analysis of all groups

Variables & groups	Flexion				Extension				Abduction				External rotation				Internal rotation			
	Mean	Δ[a)]	t-value	p-value	Mean	Δ	t-value	p-value	Mean	Δ	t-value	p-value	Mean	Δ	t-value	p-value	Mean	Δ	t-value	p-value
Scapular recruitment	9.6 ± 4.9	-	-	-	2.5 ± 2.7	-	-	-	85.1 ± 11.2	-	-	-	43.1 ± 7.7	-	-	-	26.6 ± 8.5	-	-	-
Physio-yoga	10.1 ± 5	–0.5 ± 1.8	–0.296	0.770	4.4 ± 3.9	–1.9 ± 1.2	–1.568	0.128	85.9 ± 10.7	–0.9 ± 4	–0.217	0.830	43.6 ± 8.4	–0.5 ± 2.9	–0.181	0.857	27.1 ± 6.3	–0.5 ± 2.7	–0.196	0.846
Yoga	10.3 ± 4.6	0.7 ± 1.7	0.423	0.675	3.3 ± 3.9	0.8 ± 1.2	0.649	0.521	85.9 ± 9.0	0.8 ± 3.7	0.216	0.831	43.7 ± 6.7	0.6 ± 2.6	0.228	0.821	26.9 ± 6.4	0.3 ± 2.7	0.121	0.904
Post hoc analysis of shoulder active range of motion for physio-yoga and yoga group																				
Physio-yoga	10.1 ± 5	-	-	-	4.4 ± 3.9	-	-	-	85.9 ± 10.7	-	-	-	43.6 ± 8.4	-	-	-	27.1 ± 6.3	-	-	-
Yoga	10.3 ± 4.6	0.2 ± 1.7	0.115	0.909	3.3 ± 3.9	–1.1 ± 1.4	–0.795	0.433	85.9 ± 9.0	–0.1 ± 3.6	–0.019	0.985	43.7 ± 6.7	0.1 ± 2.8	0.024	0.981	26.9 ± 6.4	–0.2 ± 2.3	–0.086	0.932

Values are presented as mean±standard deviation.
[a)]Mean difference.

reducing pain through muscle relaxation. The Physio-Yogic exercise program employs scapular recruitment exercises to gradually reach the joint's maximum discomfort or terminal range of motion in a controlled manner. To the best of our knowledge, this is the first study which combined scapular recruitment exercises with yoga asanas for Indian overhead athletes with rotator cuff tendinopathy. However, the study had its own limitations. The small sample size can be the cause of some parameters not being statistically different from one another in the observed results. Given the promising results of the study, the same principles can be applied in the development of Physio-Yogic exercise protocols for various other conditions tailored to different target populations and/or athletes.

CONCLUSION

The Physio-Yogic exercise protocol for Rotator Cuff Tendinopathy uniquely blends the advantages of scapular recruitment exercises with the well-rounded benefits of yoga asanas, including flexibility, focus, balance, concentration, and overall well-being. Therefore, it can be integrated into a rehabilitation program for Rotator Cuff Tendinopathy, leveraging the advantages of combining these exercises.

NOTES

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- **Authors' contributions:** All authors made a significant contribution to the work reported as follows: J.K.C., I.C., R.S., S.V., P.K., and V.S. participated in conception and design of the study. J.K.C., I.C., and V.S. acquired the data. G.S. performed the statistical analysis of the data. J.K.C., I.C., R.S., and G.S. interpreted the data. J.K.C., I.C., R.S., S.V., P.K., V.S. were responsible for drafting the manuscript. All authors reviewed and approved the final manuscript.
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