OPEN ACCESS

Journal of Advances in Sports and Physical Education

Abbreviated Key Title: J Adv Sport Phys Edu
ISSN 2616-8642 (Print) |ISSN 2617-3905 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: https://saudijournals.com

Original Research Article

The Impact of Proprioceptive Neuromuscular Facilitation Stretching with Yogic Asanas in Rehabilitating Rotator Cuff Strain in Young Female Throwers: A Randomized Controlled Trial

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DOI: https://doi.org/10.36348/jaspe.2026.v09i05.002 | **Received:** 09.03.2026 | **Accepted:** 06.05.2026 | **Published:** 08.05.2026

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Abstract

Rotator cuff stain causes discomfort, stiffness, decreased range of motion, diminished athletic performance, and a lower quality of life for throwers. This study aimed to determine the efficacy of Proprioceptive Neuromuscular Facilitation (PNF) stretching with Yogic Asanas in reducing pain and disability, increasing range of motion, and improving quality of life in young female throwers with rotator cuff stain. Sample from 30 female throwers was divided into three groups: PNF Technique, Yogic Asanas and Control group. Experimental groups underwent a 4-week intervention comprising PNF stretching, Yogic Asanas protocols. Pain levels were measured using the Visual Analogue Scale (VAS), and range of motion (ROM) was assessed with a goniometer. Pre-intervention readings of the Shoulder Pain and Shoulder Active Range of Motion (AROM) were taken at day 1 and post-intervention readings were taken at the end of week 4. The paired 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. Total scores of Visual Analogue Scale (VAS) ($p < 0.0001$) and Shoulder ROM ($p < 0.0001$) demonstrated statistically significant improvements in the PNF stretching and Yogic Asanas group. The PNF stretching and Yogic Asanas group significantly enhances Shoulder AROM and reduces pain in young female throwers, offering a promising rehabilitation strategy. Furthermore, the study's results revealed that groups who PNF stretching outperformed other groups in terms of improvements in Shoulder AROM and reduces Shoulder pain.

Keywords: Shoulder, Range of Motion Flexion, Extension, Abduction, External Rotation, Internal Rotation.

INTRODUCTION

In order to improve range of motion (ROM) and muscle elasticity, proprioceptive neuromuscular facilitation (PNF) stretching is a sophisticated type of flexibility training that combines passive stretching with isometric contractions. By stimulating the nervous system to relax muscles, it is very beneficial for improving athletic performance, rehabilitation, and flexibility (Adler *et al*., 2014).

Proprioceptive Neuromuscular Facilitation (PNF) is a therapeutic approach that involves stimulating proprioceptors (such as muscle spindles and Golgi tendon organs) in addition to other sensory stimuli (tactile, visual, or verbal) at the beginning (i.e., at the cognitive phase of motor learning) that gradually decrease as learning advances. Every time the muscle is held in place, it can adjust to its new position thanks to the gradual stretching and transition between contraction and relaxation. The next time, it can stretch farther because of this. Flexibility and range of motion can be improved if this is done frequently (Alexandre *et al*., 2020).

Yoga poses for rotator cuff strain rehabilitation focus on opening the chest, strengthening the shoulder girdle, and improving scapular stability to reduce the strain on injured tendons. Important poses include Adho Mukha Svanasana (modified Downward Dog), Gomukhasana (Cow Face arms), Bhujangasana (Cobra), and Uttana Shishosana (Puppy Pose). The method emphasizes stability, such as maintaining moderate external rotation in weight-bearing poses, to effectively activate the rotator cuff muscles (Kelly *et al*., 2005).

The four muscles the supraspinatus, infraspinatus, teres minor, and subscapularis all contribute to the intricate process of shoulder stabilization. Their names can be recalled using the acronym SITS. Each muscle in the shoulder produces a unique action, even though they all work together to hold the head, or ball, of the humerus in the shoulder socket (which is actually a part of the scapula, or shoulder blade). The supraspinatus attaches to the greater tuberosity of the humerus, a tiny lump on the outer upper portion of the bone, after starting on the upper scapula, directly above the scapula's spine. Shoulder abduction is started by the supraspinatus (Ferrara *et al*., 2000).

The scapula and humerus are joined by the rotator cuff muscles (supraspinatus, infraspinatus, teres minor, and subscapularis), which provide vital dynamic stability and regulate rotation and elevation. Exercises that focus on external/internal rotation and abduction to stabilize the humeral head within the glenoid fossa are used to rehabilitate these muscles during a strain (Sciarretta *et al*., 2023). A collection of tendons and muscles that encircle the shoulder is called the rotator cuff. It keeps the humerus, or upper arm bone, in its socket in the scapula, or shoulder blade. Injuries to the rotator cuff are frequent, particularly in athletes who participate in contact sports (Kibler,1998).

METHODOLOGY

This study aimed to determine the efficacy of Proprioceptive Neuromuscular Facilitation (PNF) stretching with Yogic Asanas in reducing pain and disability, increasing range of motion, and improving quality of life in young female throwers with rotator cuff stain. Sample from 30 female(N=30) (ages 16-19) throwers was divided into three groups: PNF Stretching(n=10), Yogic Asanas (n=10) and Control group(n=10). Experimental groups underwent a 4-week intervention comprising PNF stretching, Yogic Asanas protocols. Pain levels were measured using the Visual Analogue Scale (VAS), and Shoulder Active range of motion (AROM) was assessed with a goniometer. Pre-intervention readings of the Shoulder Pain and Shoulder Active Range of Motion (AROM) were taken at day 1 and post-intervention readings were taken at the end of week 4.

Proprioceptive Neuromuscular Facilitation (PNF) Stretching Protocol

Proprioceptive Neuromuscular Facilitation (PNF) stretching using the contract-relax technique was performed on ten participants in the experimental group. For four weeks, the piriformis muscle was contracted isometrically for six seconds, then relaxed and stretched passively for ten seconds. This process was repeated three times a session, five times a week. Static stretching, such as the figure-4 stretch (Reiner *et al*., 2021) and a conventional piriformis stretch, were administered to the control group three times per session at the same frequency and duration as the experimental group. Each stretch was held for twenty seconds. Additionally, both groups received standardized baseline treatments that included manual myofascial release therapy and hot pack application for 15 to 20 minutes (Agarwal *et al*., 2024).

Yogic Asanas Protocol

Ten throwers in this group received a four-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 Gomukhasana (Cow Face Arms), Garudasana (Eagle Arms), Uttana Shishosana (Puppy Pose), Bharmanasana (Tabletop Pose), Phalakasana (Plank Pose), Salabhasana (Locust Pose) and Baddha Virabhadrasana (Bound Warrior Pose).

Analysis of Data

The paired 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.

Table 1: Pre and Post Comparison of All Groups

Measuring Procedure	Variables	PNF Stretching Group				Yogic Asanas Group				Control Group			
		Pre Test Mean & SD	Post Test Mean & SD	Mean Differences	t-value	Pre Test Mean & SD	Post Test Mean & SD	Mean Differences	t-value	Pre Test Mean & SD	Post Test Mean & SD	Mean Differences	t-value
Visual Analogue Scale (VAS)	Shoulder Pain	3.80±0.40	1.70±0.46	2.10	10.92*	4.10±0.30	2.80±0.40	1.30	8.22*	3.80±0.40	3.70±0.46	0.10	0.52
Shoulder Active Range of Motion (AROM)	Flexion	120.80±3.97	137.40±4.20	16.60	9.08*	121.80±1.78	130.50±4.61	8.70	5.57*	121.70±4.84	122.60±6.76	0.90	0.34
	Extension	48.00±0.10	52.10±0.83	4.10	9.43*	47.80±1.08	50.20±1.25	2.40	4.60*	48.20±1.25	48.30±1.42	0.10	0.17
	Abduction	93.30±1.79	114.80±1.94	21.50	25.75*	94.10±2.62	108.60±4.54	14.50	8.74*	93.90±2.21	94.10±2.62	0.20	0.18
	External Rotation	48.10±1.04	57.20±3.19	9.10	8.58*	47.50±2.11	52.50±2.06	5.00	5.36*	48.40±1.36	49.10±2.34	0.70	0.82
	Internal Rotation	57.30±3.20	64.10±2.17	6.80	5.57*	57.60±3.38	61.30±3.00	3.70	2.59*	57.20±3.19	57.50±3.29	0.30	0.21

Statically Significant, SD: Standard Deviation

Table-1 reveals that, when comparing the pre and posttest mean scores in Shoulder Pain and AROM of PNF Stretching group, it is demonstrated statistically significant improvement. In the Shoulder Pain score, it is decreased from 3.80±0.40 to 1.70±0.46, in the Shoulder Flexion AROM, it is increased from 120.80±3.97 to 137.40±4.20, in Shoulder Extension AROM, it is increased from 48.00±0.10 to 52.10±0.83, Shoulder Abduction AROM, it is increased from 93.30±1.79 to 114.80±1.94, In the score of Shoulder External Rotation AROM it is increased from 48.10±1.04 to 57.20±3.19, and shoulder Internal Rotation AROM Scores, it is increased from 57.30±3.20 to 64.10±2.17.

The Yogic Asanas group pre and posttest mean scores also showed statistically significant improvement in Shoulder Pain and AROM. In the Shoulder Pain score, it is decreased from 4.10±0.30 to 2.80±0.40, in the Shoulder Flexion AROM, it is increased from 121.80±1.78 to 130.50±4.61, in Shoulder Extension AROM, it is increased from 47.80±1.08 to 50.20±.25, Shoulder Abduction AROM, it is increased from 94.10±2.62 to 108.60±4.54, In the score of Shoulder External Rotation AROM it is increased from 47.50±2.11 to 52.50±2.06, and shoulder Internal Rotation AROM Scores, it is increased from 57.60±3.38 to 61.30±3.00. It was concluded that experimental groups such as PNF Stretching group, and Yogic Asanas

group had registered statistically significant improvement on Shoulder Pain and AROM Scores. Further the results showed that, there was no statistically significant improvement in Shoulder Pain and AROM in Control group.

Table 2: Comparison of Adjusted Mean Improvement Between all Groups (ANCOVA)

Measuring Procedure	Variables	PNF Stretching Group	Yogic Asanas Group	Control Group	F-value	p-value
Visual Analogue Scale (VAS)	Shoulder Pain	1.75	2.70	3.75	53.93	0.0001
Shoulder Active Range of Motion (AROM)	Flexion	137.82	130.26	122.43	23.00	0.0001
	Extension	52.10	50.35	48.15	50.81*	0.0001
	Abduction	114.95	108.49	94.06	99.57*	0.0001
	External Rotation	57.13	52.83	48.83	26.75*	0.0001
	Internal Rotation	64.15	61.11	57.63	69.79*	0.0001

Statically Significant

The table-2 reveals that, when comparing the adjusted posttest mean changes in Shoulder Pain and AROM values among the PNF Stretching group, Yogic Asanas group and Control group, ANCOVA testing revealed significant differences. notably, the PNF Stretching group and Yogic Asanas group exhibited a significant reduction in the adjusted posttest mean score in Shoulder Pain (1.75, 2.70) ($F = 53.95$; $p = 0.0001$), Shoulder Flexion (137.82, 130.26) ($F = 23.00$; $p = 0.0001$), Shoulder Extension (52.10, 50.35) ($F = 50.81$; $p = 0.0001$), Shoulder Abduction (114.9, 108.49) ($F = 99.57$; $p = 0.0001$), Shoulder External Rotation (57.13, 52.83) ($F = 26.75$; $p = 0.0001$) and Shoulder Internal Rotation (64.15, 61.11) ($F = 69.79$; $p = 0.0001$).

Table 3: Post Hoc Analysis of All Groups

Measuring Procedure	Variables	Adjusted Post-test Means			Mean Difference	Confidence Interval
		PNF Stretching Group	Yogic Asanas Group	Control Group		
Visual Analogue Scale (VAS)	Shoulder Pain	1.75	2.70		0.95*	0.49
		1.75		3.75	2.00*	0.49
			2.70	3.75	1.05*	0.49
Shoulder Active Range of Motion (AROM)	Flexion	137.82	130.26		7.56*	5.74
		137.82		122.43	15.39*	5.74
			130.26	122.43	7.83*	5.74
	Extension	52.10	50.35		1.75*	1.00
		52.10		48.15	3.95*	1.00
			50.35	48.15	2.20*	1.00
	Abduction	114.95	108.49		6.46*	3.84
		114.95		94.06	20.90*	3.84
			108.49	94.06	14.43*	3.84
	External Rotation	57.13	52.83		4.30*	2.88
		57.13		48.83	8.30*	2.88
			52.83	48.83	4.00*	2.88
	Internal Rotation	64.15	61.11		3.04*	1.40
		64.15		57.63	6.52*	1.40
			61.11	57.63	3.48*	1.40

Statically Significant

The table-3 post hoc analysis revealed significant improvements in various measures.

- The results indicated that their significant differences were found in Shoulder Pain of PNF Stretching group and Yogic Asanas group (0.95), PNF Stretching group and Control group (2.00), Yogic Asanas group and Control group (1.05). The Confidence Interval score is 0.49.
- The results indicated that their significant differences were found in Shoulder Flexion of PNF Stretching group and Yogic Asanas group (7.56), PNF Stretching group and Control group (15.39), Yogic Asanas group and Control group (7.83). The Confidence Interval score is 5.74.
- The results indicated that their significant differences were found in Shoulder Extension of PNF Stretching group and Yogic Asanas

group (1.75), PNF Stretching group and Control group (3.95), Yogic Asanas group and Control group (2.20). The Confidence Interval score is 1.00.

- The results indicated that their significant differences were found in Shoulder Abduction of PNF Stretching group and Yogic Asanas group (6.46), PNF Stretching group and Control group (20.90), Yogic Asanas group and Control group (14.43). The Confidence Interval score is 3.84.
- The results indicated that their significant differences were found in Shoulder External Rotation of PNF Stretching group and Yogic Asanas group (4.30), PNF Stretching group and Control group (8.30), Yogic Asanas group and Control group (4.00). The Confidence Interval score is 2.88.
- The results indicated that their significant differences were found in Shoulder Internal Rotation of PNF Stretching group and Yogic Asanas group (3.04), PNF Stretching group and Control group (6.52), Yogic Asanas group and Control group (3.48). The Confidence Interval score is 1.40.

The graphical representation of pretest, post-test and adjusted posttest mean values of PNF Stretching group and Yogic Asanas group and Control Group on selected variables are presented is in Figure-1 to Figure 6.

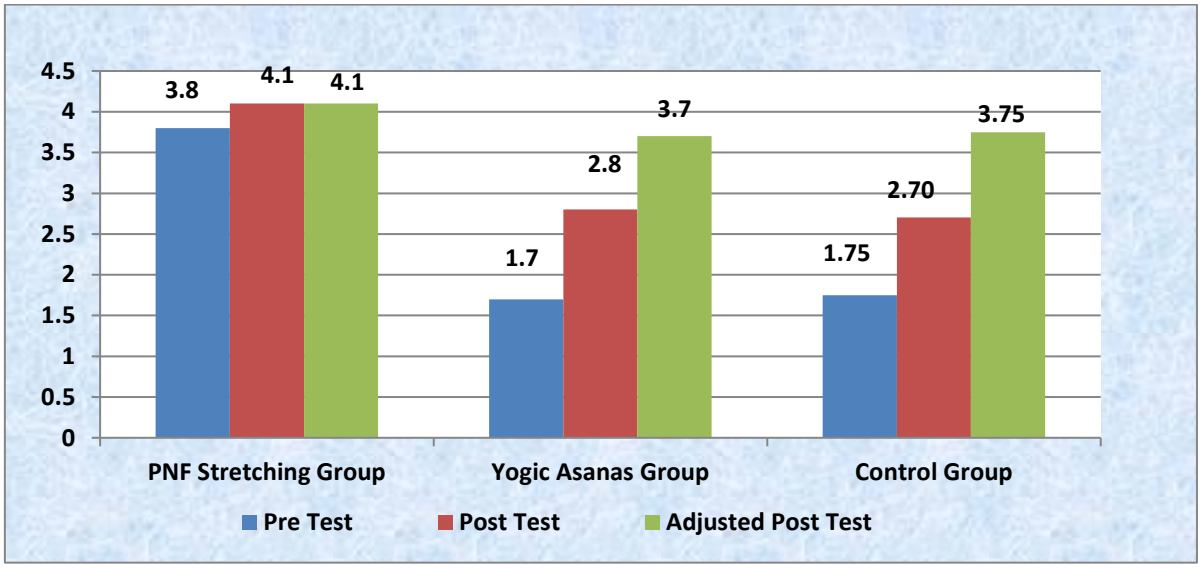

Fig. 1: Pre, Post and Adjusted Post Test Mean Scores on Shoulder Pain (Cm)

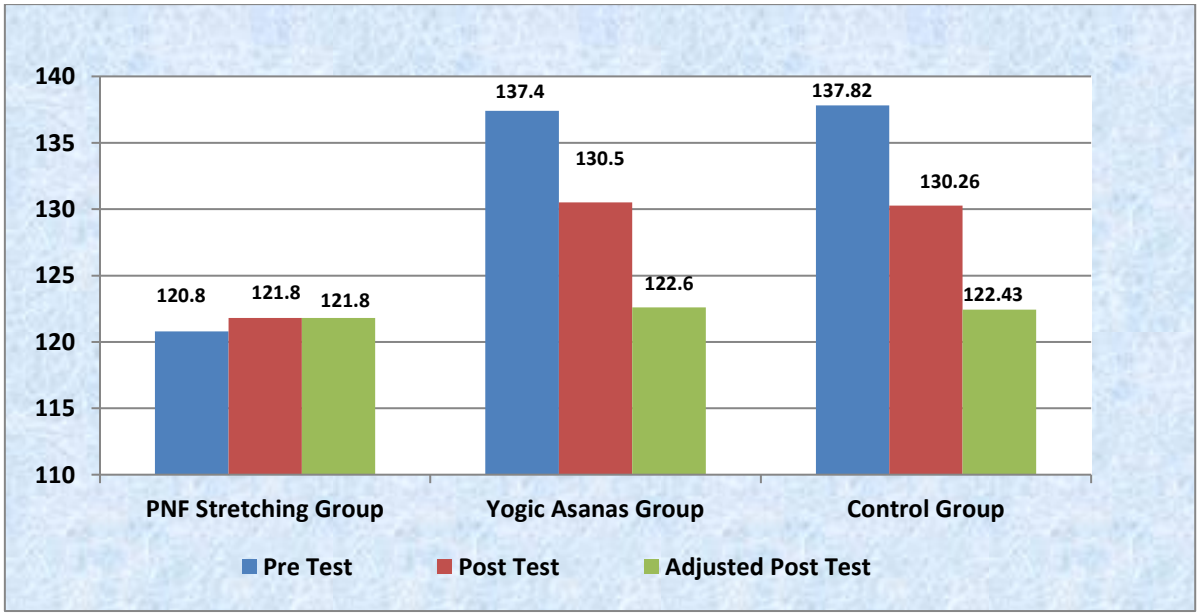

Fig. 2: Pre, Post and Adjusted Post Test Mean Scores on Shoulder Flexion (degree)

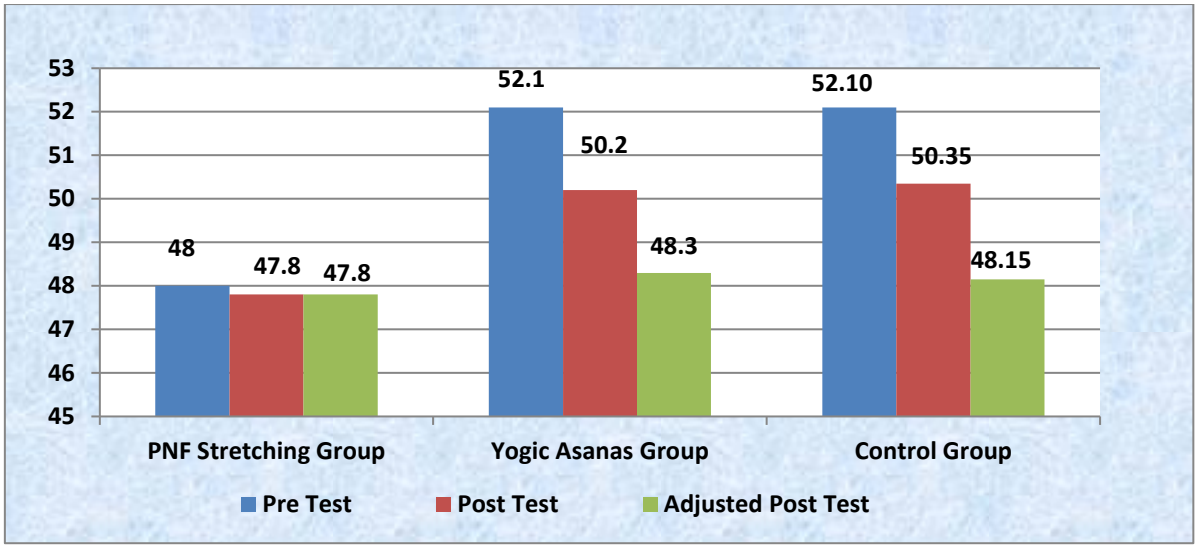

Fig. 3: Pre, Post and Adjusted Post Test Mean Scores on Shoulder Extension (degree)

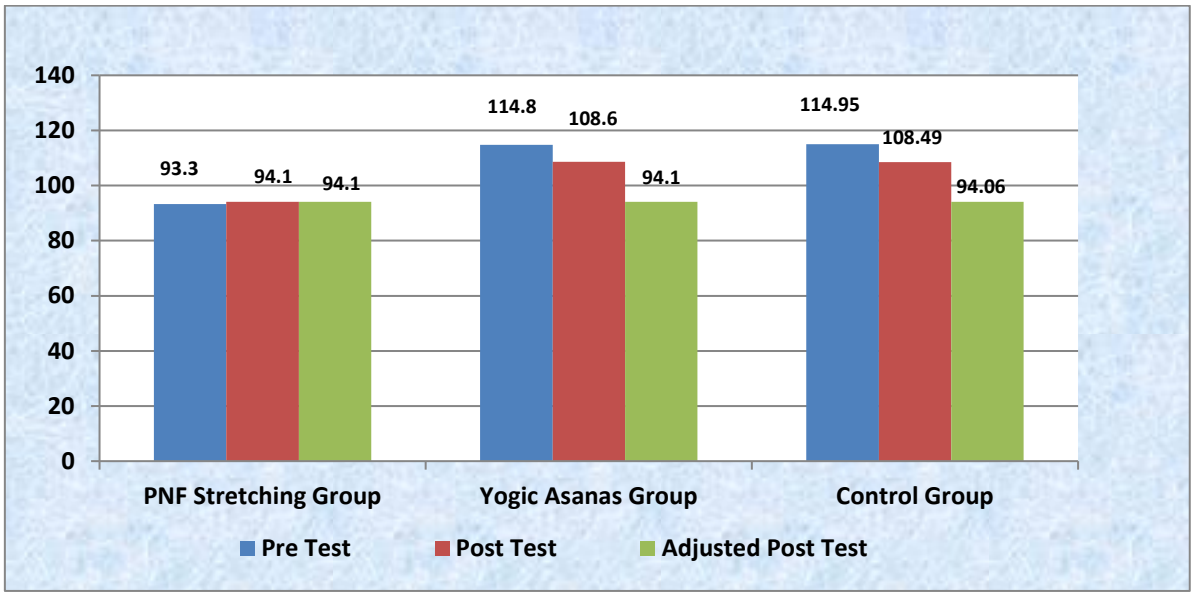

Fig. 4: Pre, Post and Adjusted Post Test Mean Scores on Shoulder Abduction (degree)

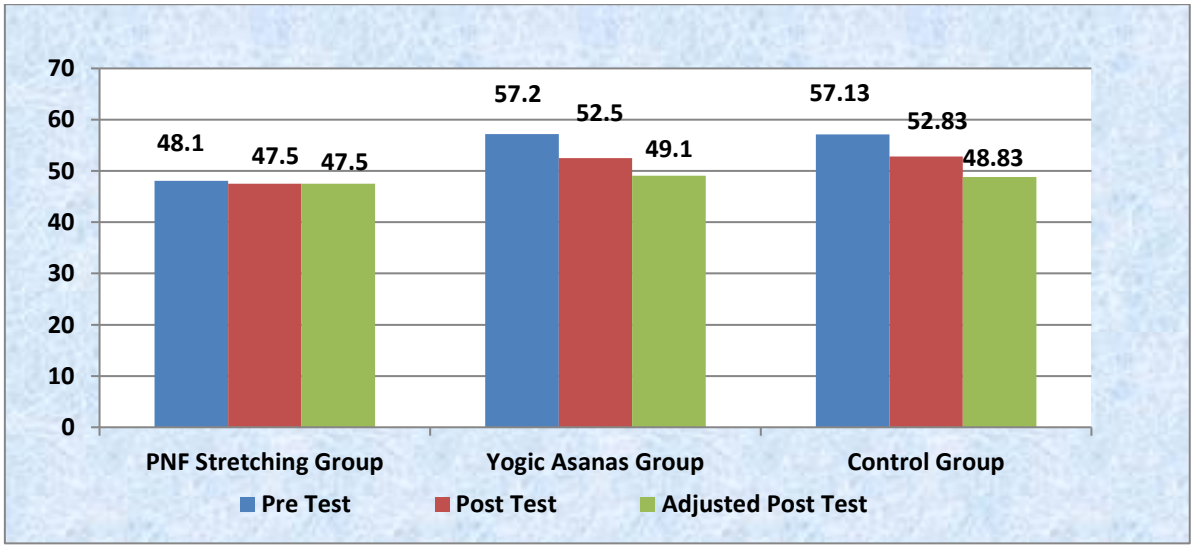

Fig. 5: Pre, Post and Adjusted Post Test Mean Scores on Shoulder External Rotation (degree)

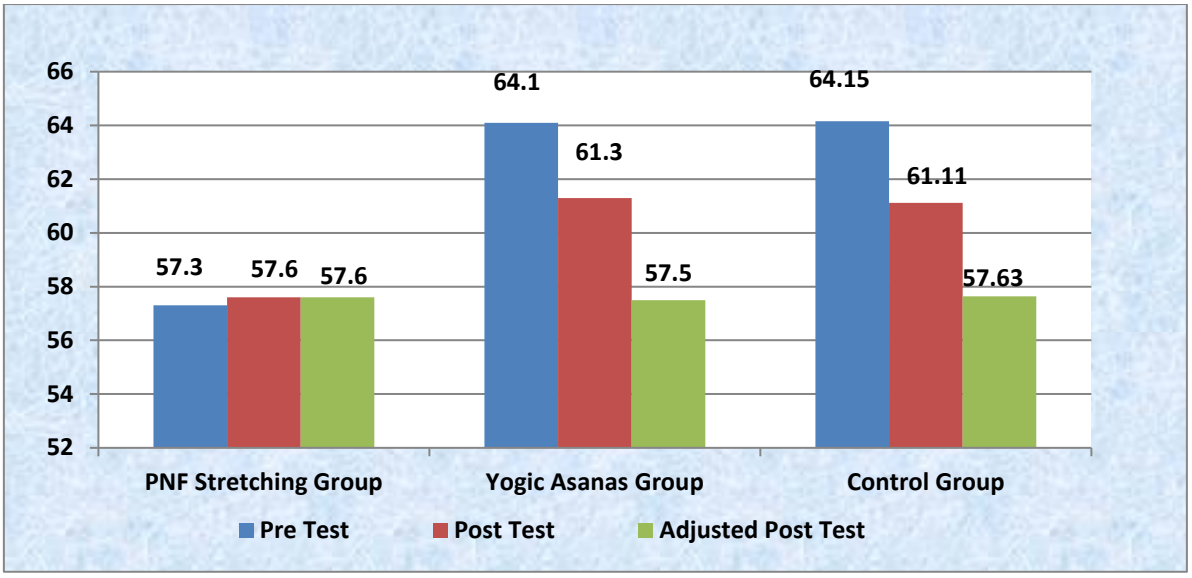

Fig. 6: Pre, Post and Adjusted Post Test Mean Scores on Shoulder Internal Rotation (degree)

CONCLUSIONS

Significant differences in achievement were found between PNF Stretching group, Yogic Asanas group and Control group on Shoulder Pain and AROM. The experimental groups namely PNF Stretching group, Yogic Asanas group had significantly decrease in Shoulder Pain and increase in AROM. The PNF Stretching group was found to be better than the Yogic Asanas group and Control group in decreasing Shoulder Pain and increasing AROM. Therefore, it can be integrated into a rehabilitation program for Rotator Cuff strain leveraging the advantages of combining these exercises among the young female thrower.

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