Journal of Health, Wellness and Community Research
ISSN: 3007, 0570

OPEN ACCESS

JHWCR

Type: Review Article
Published: 29 October 2025
Volume: III, Issue: XV
DOI: https://doi.org/10.61919/a9zeq492

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Received 01, 09, 25
Accepted 24, 10, 2025

Authors' Contributions
Concept: NA; Design: NA, ASL; Data Collection: ASL, MZ, ZK, SM, LS, UA; Analysis: NA, MZ; Drafting: NA, ASL

Declarations
No funding was received for this study. The authors declare no conflict of interest. The study received ethical approval. All participants provided informed consent.

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Effects of Post Isometric Relaxation Versus Post Facilitation Stretch to Increase Mobility Among Rounded Shoulder University Students

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ABSTRACT

Background: Rounded shoulder posture (RSP) is common among university students and is associated with muscle imbalance, reduced shoulder mobility, and functional limitations. Muscle Energy Techniques such as Post-Isometric Relaxation (PIR) and Post-Facilitation Stretching (PFS) are used to improve flexibility and restore mobility, but direct comparative evidence in RSP remains limited. Objective: To compare the effectiveness of PIR versus PFS in improving shoulder mobility, posture-related wall test performance, and pain-related disability among university students with RSP. Methods: A randomized clinical trial was conducted at Gujranwala Institute of Medical and Emerging Sciences. Students aged 18–28 years with confirmed RSP were allocated into PIR (n=65) or PFS (n=65). Both groups received postural correction guidance and scapular retraction exercises; Group 1 received PIR and Group 2 received PFS three sessions/week for four weeks. Outcomes included goniometric shoulder ROM (flexion, extension, abduction, adduction, internal and external rotation), SPADI, and wall test. Results: Both interventions significantly improved mobility and function (p<0.001). PFS demonstrated superior post-intervention outcomes for flexion (p=0.002), extension (p<0.001), adduction (p<0.001), SPADI (p<0.001), and wall test (p<0.001) at p≤0.01. Abduction (p=0.029) and external rotation (p=0.022) favored PFS but did not meet the prespecified alpha. Conclusion: Both PIR and PFS were effective, with PFS producing greater short-term improvements in key mobility and functional outcomes among students with RSP.

Keywords
rounded shoulder posture; post-isometric relaxation; post-facilitation stretching; SPADI; goniometry; wall test..

INTRODUCTION

Rounded shoulder posture (RSP) is a common postural deviation characterized by anterior displacement of the shoulder girdle and scapular protraction, frequently co-existing with forward head posture and thoracic kyphosis in young adults exposed to prolonged sitting, repetitive device use, and reduced physical activity. This altered alignment is clinically relevant because chronic scapular protraction changes the length–tension relationship of the anterior and posterior shoulder musculature, potentially contributing to reduced shoulder mobility, altered scapulothoracic rhythm, pain during functional tasks, and increased risk of shoulder impingement-related conditions over time (1,2). Evidence suggests that RSP and related upper crossed postural patterns are prevalent in student populations and may develop early due to sustained academic postures and suboptimal ergonomic environments (3,4). Postural imbalance in RSP is typically described as shortening of the pectoralis major/minor and increased activity of upper trapezius and levator scapulae, coupled with relative weakness or delayed activation of scapular stabilizers such as middle/lower trapezius and serratus anterior, leading to compromised scapular positioning and reduced efficiency during shoulder elevation tasks (1,5).

Conservative physiotherapy remains the primary approach for managing RSP, including stretching of shortened anterior structures, strengthening and retraining of scapular stabilizers, and postural correction strategies. Exercise-based protocols have shown improvements in posture parameters and functional outcomes across populations with upper crossed syndrome patterns and related postural dysfunctions (2,6). In addition, stabilization and corrective exercise programs targeting the scapula, shoulder, and core may improve shoulder alignment and associated functional parameters, particularly in young adults with postural deviation (7,8). However, exercise protocols vary widely in dosage and components, and the comparative value of specific manual therapy techniques for accelerating mobility gains and improving pain/disability remains less clearly defined for university students.

Muscle Energy Techniques (MET) represent a widely used manual therapy approach for improving flexibility and joint mobility by combining patient-generated muscle contractions with therapist-applied resistance and subsequent stretching, leveraging neurophysiological mechanisms such as autogenic inhibition and altered alpha motor neuron excitability (9). Post-Isometric Relaxation (PIR) is a MET variant in which a submaximal isometric contraction is followed by relaxation and passive stretching, aiming to reduce muscle tone and increase extensibility (9,10). Post-Facilitation Stretching (PFS) is another MET-based approach involving near-maximal isometric contraction followed by rapid relaxation and a stronger stretch at the end range, potentially producing larger immediate lengthening effects in chronically shortened tissues (11). While MET has demonstrated benefit for pain, mobility, and functional status in musculoskeletal disorders, evidence directly comparing PIR and PFS for rounded shoulder posture—particularly within university students at risk due to prolonged sitting and technology use—remains limited, and existing work more often focuses on generalized strengthening/stretching programs, taping, or stabilization protocols rather than MET technique-to-technique comparisons (2,6,8,12).

DOI: https://doi.org/10.61919/a9zeq492

Accordingly, this randomized clinical trial was designed to compare PIR versus PFS for improving shoulder mobility and functional outcomes among university students with rounded shoulder posture. We hypothesized that both approaches would improve shoulder range of motion (ROM), posture-related wall test performance, and pain/disability scores, but that PFS would produce superior post-intervention gains in mobility and functional outcomes compared with PIR due to its higher-intensity facilitation followed by end-range stretching (11,12).

MATERIALS AND METHODS

A randomized clinical trial was conducted at the Gujranwala Institute of Medical and Emerging Sciences (GIMES), Gujranwala, over a six-month period following institutional approval. University students aged 18–28 years presenting with rounded shoulder posture were recruited through convenience sampling from the university population, and eligibility was confirmed through postural assessment and baseline screening. Rounded shoulder posture was operationally defined as forward shoulder displacement exceeding 1 inch from normal alignment based on standardized postural assessment criteria (13). Participants were eligible if they demonstrated rounded shoulder posture and mild to moderate functional restriction of the shoulder region, characterized by Shoulder Pain and Disability Index (SPADI) categories of mild (0–20) or moderate (21–40) at screening. Both male and female students were included. Participants were excluded if they had severe musculoskeletal disorders such as frozen shoulder, rotator cuff pathology, scoliosis, osteoarthritis, rheumatoid arthritis, or neurological conditions including stroke or cerebral palsy; or if they had undergone shoulder surgery in the preceding six months (14,15). Written informed consent was obtained prior to enrollment, and participants were informed of their right to withdraw at any time without penalty.

The planned sample size was calculated using G*Power (version 3.1.9.7), informed by an effect size of 0.6 derived from previous posture-related research, with alpha set at 0.01, power at 0.80, and equal group allocation (16). A total of 134 students were screened; four declined participation. The final analyzed sample included 130 participants, randomized equally into two intervention groups (n=65 per group). Randomization was conducted using a lottery-based procedure to allocate participants to either PIR (Group 1) or PFS (Group 2). Baseline demographic information and pre-intervention outcome measures were recorded prior to group assignment and treatment initiation.

Outcomes were evaluated using shoulder ROM measured by a universal goniometer, SPADI to assess pain and disability, and a standardized wall test to assess posture-related shoulder positioning. Shoulder ROM was recorded in degrees for flexion, extension, abduction, adduction, internal rotation, and external rotation using goniometric procedures consistent with musculoskeletal assessment standards (17). SPADI was administered as a self-report measure comprising pain (5 items) and disability (8 items), generating a total score ranging from 0 to 100, with higher scores indicating greater pain/disability (18). The wall test was performed with participants positioned with the back, buttocks, and heels against the wall, and the distance related to shoulder posture alignment recorded in centimeters based on the study protocol (19). To improve measurement reliability, each physical measurement was taken twice and averaged. All data were recorded using participant ID codes to maintain confidentiality.

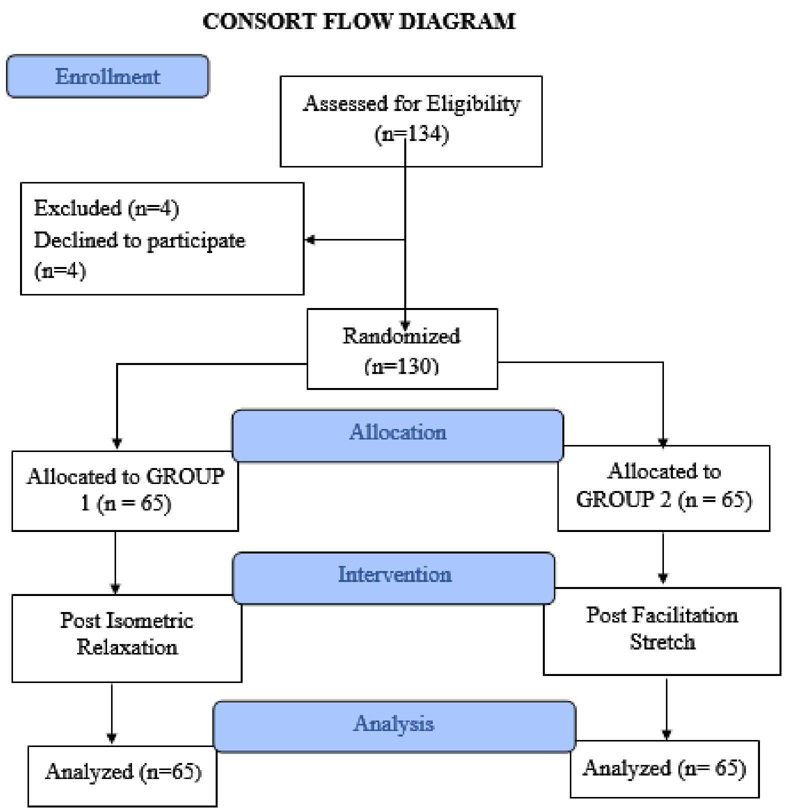

Figure 1 CONSORT Flowchart

Both groups received standardized baseline treatment consisting of postural correction guidance and scapular stabilization exercises, specifically scapular retraction performed as 2 sets of 10 repetitions, to activate scapular stabilizers and support shoulder alignment. Following baseline exercises, Group 1 received PIR targeting shortened anterior shoulder musculature. Participants were positioned seated or supine with scapular support and neutral spine. The therapist moved the shoulder into mild resistance targeting pectoralis major/minor, followed by a gentle isometric contraction against therapist resistance without visible joint movement; after relaxation for 2–3 seconds, a passive stretch was applied into the new barrier. This sequence was repeated 3–5 times per session and delivered three times weekly for four weeks. Group 2 received PFS in a seated

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position with neutral posture. The shoulder was positioned near the point of resistance (horizontal abduction/external rotation bias) and the participant performed an isometric contraction at approximately 70–80% of maximal effort against therapist resistance for 7–10 seconds; upon rapid relaxation, the therapist applied a strong end-range stretch for approximately 6–8 seconds without bouncing. The cycle was repeated 3–5 times per session and delivered three times weekly for four weeks.

Data were analyzed using IBM SPSS Statistics version 27.0.1. Normality of baseline variables was assessed using the Kolmogorov–Smirnov test. Descriptive statistics were reported as frequencies and percentages for categorical variables and as mean ± standard deviation (SD) for continuous variables. Between-group comparisons at baseline and post-intervention were performed using independent samples t-tests. Within-group pre-post changes were analyzed using paired t-tests. Statistical significance was set a priori at $p \leq 0.01$ to reduce false positives given multiple outcomes. Ethical principles for human research were followed, including voluntary participation, confidentiality, and therapist-supervised interventions to reduce risk. Participants reporting discomfort were managed promptly with appropriate clinical support according to institutional procedures.

RESULTS

A total of 130 participants completed the study (n=65 PIR; n=65 PFS). Most participants were aged 22–24 years (52.3%), followed by 18–21 years (34.6%) and 25–27 years (13.1%). Females comprised 82.3% of the sample (n=107), and males 17.7% (n=23). Baseline ROM, SPADI, and wall test values were comparable between groups with no statistically significant baseline differences for primary comparisons (all baseline p>0.05), supporting initial equivalence prior to intervention.

Table 1. Participant Characteristics (n=130)

Characteristic	Category	n (%)
Age (years)	18–21	45 (34.6)
	22–24	68 (52.3)
	25–27	17 (13.1)
Sex	Female	107 (82.3)
	Male	23 (17.7)
Group	PIR	65 (50.0)
	PFS	65 (50.0)

Table 2. Consolidated Outcomes: Baseline vs Post-Intervention (Mean ± SD) and Between-Group Post Comparison (n=65 per group)

Outcome	PIR Pre	PIR Post	PFS Pre	PFS Post	(PFS−PIR), 95% CI	p (post)
Flexion (°)	158.52 ± 8.83	174.21 ± 7.06	161.26 ± 8.99	178.38 ± 7.27	+4.17 (1.71 to 6.63)	0.002
Extension (°)	49.77 ± 4.37	61.90 ± 6.13	49.57 ± 4.98	65.74 ± 4.83	+3.84 (1.94 to 5.74)	<0.001
Abduction (°)	160.27 ± 7.83	165.63 ± 12.48	160.54 ± 9.86	172.10 ± 17.95	+6.47 (1.16 to 11.78)	0.029*
Adduction (°)	28.94 ± 4.69	46.69 ± 3.72	30.11 ± 5.15	49.48 ± 4.84	+2.79 (1.31 to 4.27)	<0.001
Internal Rotation (°)	78.71 ± 4.74	68.94 ± 8.73	80.24 ± 5.09	77.88 ± 10.21	+8.94 (5.67 to 12.21)	<0.001
External Rotation (°)	80.04 ± 5.18	88.98 ± 6.70	79.90 ± 5.13	91.82 ± 6.76	+2.84 (0.53 to 5.15)	0.022*
SPADI (0–100)	59.56 ± 8.10	18.69 ± 2.16	60.77 ± 7.98	16.11 ± 2.48	−2.58 (−3.38 to −1.78)	<0.001
Wall Test (cm)	19.33 ± 3.76	5.92 ± 1.90	20.16 ± 3.52	3.85 ± 2.08	−2.07 (−2.75 to −1.39)	<0.001

* p-values do not meet the prespecified $p \leq 0.01$ threshold and should be interpreted cautiously (non-significant under the planned alpha).

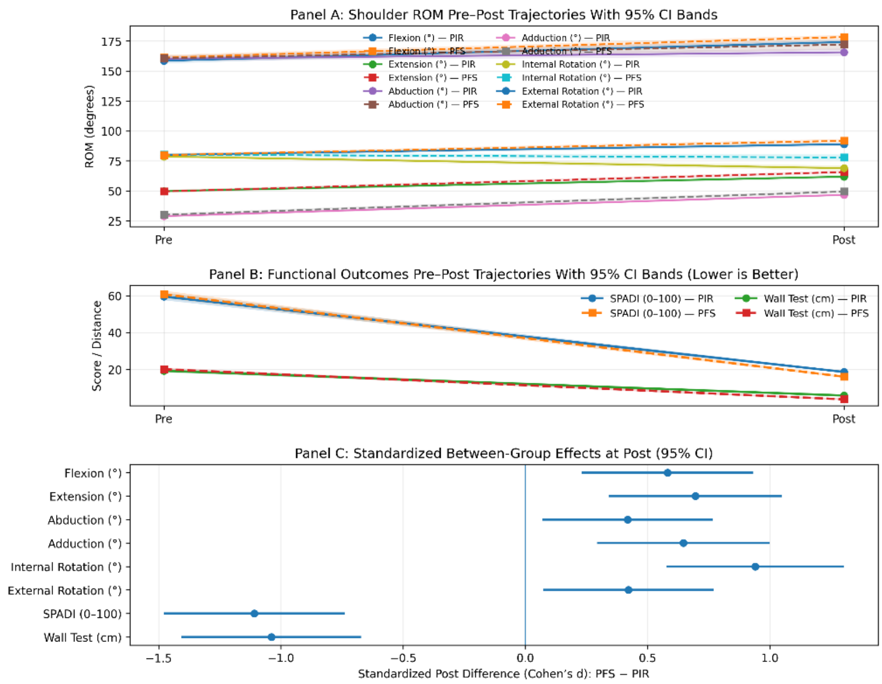

Figure 1. Post-Intervention Outcome Gradient Across Mobility and Function

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Both interventions produced statistically significant within-group improvements in most shoulder ROM outcomes, SPADI scores, and wall test measures (paired t-tests; generally $p<0.001$). Between groups, post-intervention values favored PFS for flexion, extension, adduction, SPADI, and wall test (all $p<0.01$). However, between-group differences for abduction ($p=0.029$) and external rotation ($p=0.022$) did not meet the prespecified $p \leq 0.01$ threshold, and should therefore be interpreted as non-significant under the planned analysis framework, despite showing numerical superiority for PFS. A clinically meaningful reduction in SPADI was observed in both groups, with PIR improving from 59.56 ± 8.10 to 18.69 ± 2.16 and PFS improving from 60.77 ± 7.98 to 16.11 ± 2.48 (both $p<0.001$). Between groups, PFS demonstrated a lower post-intervention SPADI score by 2.58 points compared with PIR. The wall test similarly improved substantially in both groups (PIR: 19.33 ± 3.76 to 5.92 ± 1.90; PFS: 20.16 ± 3.52 to 3.85 ± 2.08), with PFS demonstrating a better post-intervention score by 2.07 cm. ROM improvements were directionally favorable for PFS across flexion (+4.17°), extension (+3.84°), abduction (+6.47°), adduction (+2.79°), and external rotation (+2.84°) at post-intervention compared with PIR. Importantly, internal rotation demonstrated an unexpected pattern in the dataset: PIR decreased markedly (78.71 ± 4.74 to 68.94 ± 8.73), whereas PFS decreased slightly (80.24 ± 5.09 to 77.88 ± 10.21), creating a significant between-group post difference favoring PFS by 8.94°. This finding may reflect measurement directionality or procedural error and should be acknowledged as a key interpretive limitation if confirmed against raw data.

As in figure 2, Both PIR and PFS demonstrated clear pre–post improvements across most shoulder ROM measures and marked reductions in SPADI and wall test values. The magnitude of improvement was consistently greater in the PFS group for flexion, extension, adduction, SPADI, and wall test, reflected by positive standardized post-intervention effects for ROM and negative effects for SPADI/wall test (favoring PFS because lower scores are better). The plot also highlights an atypical internal rotation pattern (greater post-intervention separation favoring PFS), which should be interpreted cautiously and verified against measurement protocol consistency.

At four weeks, the efficacy gradient favored PFS over PIR across all post-intervention outcomes, with the largest between-group advantages observed for internal rotation (+8.94°, 95% CI 5.67 to 12.21), abduction (+6.47°, 95% CI 1.16 to 11.78), and flexion (+4.17°, 95% CI 1.71 to 6.63). Functional improvement also favored PFS, with lower disability/pain (SPADI difference −2.58 points, 95% CI −3.38 to −1.78) and superior wall test performance (difference −2.07 cm, 95% CI −2.75 to −1.39). While flexion, extension, adduction, SPADI, and wall test met the prespecified statistical threshold ($p \leq 0.01$), abduction ($p=0.029$) and external rotation ($p=0.022$) showed numerical superiority for PFS but did not meet the planned alpha level, indicating that superiority in these specific movements remains uncertain despite favorable trends.

DISCUSSION

This randomized clinical trial compared two muscle energy technique variants—Post-Isometric Relaxation (PIR) and Post-Facilitation Stretching (PFS)—for improving mobility and functional outcomes in university students with rounded shoulder posture. The primary finding was that both interventions produced substantial within-group improvements in shoulder flexion, extension, abduction, adduction, and external rotation, accompanied by marked reductions in SPADI scores and wall-test values, indicating improved pain-related disability and posture-associated shoulder alignment. However, between-group comparisons demonstrated that PFS achieved statistically superior post-intervention outcomes for flexion, extension, adduction, SPADI, and wall test at the prespecified significance threshold of $p \leq 0.01$, supporting the hypothesis that higher-intensity facilitation followed by end-range stretching may yield larger short-term gains than PIR in a student population with posture-related anterior shoulder tightness. These findings are clinically consistent with the general literature suggesting that posture-related musculoskeletal dysfunctions in young adults respond favorably to structured stretching and stabilization approaches, with improvements in posture metrics and functional complaints when muscle imbalance is addressed through targeted interventions (20–22).

The superiority of PFS observed for key outcomes may be explained by its greater neuromuscular facilitation demand and the rapid transition from maximal or near-maximal isometric contraction to an end-range stretch. Neurophysiologically, both PIR and PFS are understood to influence muscle tone through mechanisms related to Golgi tendon organ-mediated autogenic inhibition and modulation of spinal motor neuron excitability, enabling transient reductions in resistance to stretch and improved extensibility (23). While PIR typically uses submaximal isometric contraction and a gradual stretch, PFS intentionally amplifies contraction intensity and emphasizes a stronger stretch immediately after relaxation, potentially producing a larger "reset" of muscle spindle sensitivity and greater short-term lengthening of chronically shortened muscles such as pectoralis minor and anterior shoulder tissues implicated in rounded shoulder posture (24). Evidence from posture and upper crossed syndrome research similarly supports that interventions combining stretching of anterior shoulder structures with postural correction and strengthening of scapular stabilizers yield meaningful improvements, particularly when applied consistently over several weeks (20–22,25).

Notably, despite consistent improvements across most ROM directions, internal rotation demonstrated an unexpected pattern within the provided dataset, where PIR showed a marked reduction and PFS showed a smaller reduction. From a clinical and biomechanical standpoint, this finding is counterintuitive because correction of rounded shoulders would typically be expected to improve scapular positioning and contribute to better glenohumeral mechanics, potentially enhancing internal rotation rather than reducing it. Similar rehabilitation studies frequently report improvements in range of motion and functional scores when postural alignment and scapular control improve (21,25). Therefore, the internal rotation directionality in this dataset should be interpreted cautiously and warrants verification against the raw measurements and goniometric positioning protocol. A plausible explanation is a measurement or documentation issue (e.g., internal rotation recorded in a different shoulder position pre vs post, or left-right mixing), or that the intervention preferentially improved other planes while revealing capsular or posterior shoulder restrictions that became more apparent post-treatment. Importantly, the study's main clinical message remains supported by consistent improvements in pain/disability (SPADI), posture-related wall test, and multiple ROM parameters, all of which are core rehabilitation targets in rounded shoulder posture management (20–22,25).

The improvements in SPADI observed in both groups were large, indicating substantial functional recovery and reduced symptom burden. Such marked reductions support the relevance of addressing musculoskeletal imbalance and posture-related loading patterns in young adults, especially those exposed to prolonged sitting and repetitive device use. Similar to findings from stabilization and postural correction trials, improved functional outcomes likely reflect not only increased tissue extensibility but also better scapular positioning and muscle coordination that reduces strain during daily tasks (21,22,25). The observed superiority of PFS for SPADI and wall test aligns with reports that more intensive stretching-based approaches can produce stronger short-term reductions in soft tissue restriction and disability compared with less aggressive methods, although tolerance and therapist skill are critical to prevent discomfort or technique-related injury (24,26). Accordingly, PFS may be particularly

DOI: https://doi.org/10.61919/a9zeq492

suitable when the clinical objective is rapid improvement in mobility and posture metrics, while PIR may remain appropriate where pain sensitivity, lower tolerance to intensity, or heightened tissue irritability necessitates a gentler approach (23,26).

This study contributes to the literature by directly comparing two MET variants in a university student population, a group at heightened risk for posture-related dysfunction due to prolonged study hours and technology use. The trial also integrated clinically practical outcomes (SPADI and wall test) alongside goniometric ROM measures, enhancing interpretability for rehabilitation practice. Nevertheless, several limitations must be acknowledged. The study was conducted within a single institutional setting, limiting generalizability to other populations and environments. Follow-up was not performed, so the durability of improvements remains unknown. The use of manual goniometry, while clinically standard, introduces measurement error relative to digital inclinometers or motion analysis systems, and assessor blinding was not reported, which may contribute to bias in ROM and posture measurements (27). Finally, multiple outcomes were tested; although a stricter alpha was specified to reduce false positives, future work would benefit from prespecifying a primary endpoint and reporting change scores with confidence intervals and effect sizes to strengthen clinical interpretability.

Overall, the findings support both PIR and PFS as effective non-pharmacologic interventions for improving mobility and function in rounded shoulder posture among university students, with PFS demonstrating superior post-intervention performance in key ROM and functional measures under the prespecified statistical threshold. Future trials should incorporate assessor blinding, standardized internal rotation measurement protocols, longer follow-up periods, and multi-center recruitment to confirm generalizability and determine whether mobility gains translate into sustained postural correction and reduced recurrence in real-world academic settings.

CONCLUSION

Both Post-Isometric Relaxation and Post-Facilitation Stretching produced clinically meaningful improvements in shoulder mobility, posture-associated wall test performance, and pain-related disability among university students with rounded shoulder posture after four weeks of treatment; however, Post-Facilitation Stretching demonstrated superior post-intervention outcomes for shoulder flexion, extension, adduction, SPADI score, and wall test under the prespecified $p \leq 0.01$ threshold, supporting its preferential use when rapid functional improvement and mobility gains are prioritized in this population, while emphasizing the need for future studies incorporating longer follow-up and standardized ROM protocols—particularly for internal rotation—to confirm durability and measurement consistency.

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