IJBPAS, July, 2026, 15(7): 3452-3460

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

EFFICACY OF POST-ISOMETRIC RELAXATION ON BILATERAL CALF TIGHTNESS IN SCHOOL TEACHERS WITH PLANTAR FASCIITIS: AN EXPERIMENTAL STUDY

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Received 24th June 2025; Revised 20th July 2025; Accepted 21st Oct. 2025; Available online 1st July 2026

https://doi.org/10.31032/IJBPAS/2026/15.7.10354

ABSTRACT

Introduction: Plantar fasciitis is a prevalent musculoskeletal condition commonly seen in professionals with prolonged standing postures, such as school teachers. Tightness in the calf muscles is a key contributing factor, leading to increased strain on the plantar fascia. Post-Isometric Relaxation (PIR), a form of Muscle Energy Technique, aims to reduce muscle tightness through a sequence of isometric contraction followed by passive stretching. This pilot study investigates the efficacy of PIR in reducing bilateral calf tightness and pain in school teachers with plantar fasciitis.

Materials and Methodology: A total of 30 school teachers diagnosed with plantar fasciitis and bilateral calf tightness were recruited for this pilot study. Participants underwent a PIR intervention targeting the gastrocnemius and soleus muscles over a period of 2 weeks. Outcome measures included the Dorsiflexion Lunge Test to assess calf flexibility and the Numerical Pain Rating Scale to evaluate pain levels. Pre- and post-intervention scores were recorded and analyzed.

Result: A paired t test was used for statistical analysis (CI 95%, $p < 0.05$). Data was collected at baseline and after two weeks of intervention.

Conclusion: Post-Isometric Relaxation appears to be a promising therapeutic approach in reducing calf muscle tightness and pain in school teachers with plantar fasciitis. This study supports the need for further research with a larger sample size to establish the clinical effectiveness of PIR.

Keywords: Post-isometric relaxation, NPRS, flexibility, plantar fasciitis, tightness

INTRODUCTION

Plantar fasciitis is a common and often debilitating condition that affects the plantar fascia—a thick band of tissue connecting the heel bone to the toes. It is primarily characterized by pain in the heel and bottom of the foot, particularly during the first steps in the morning or after periods of rest. The condition is particularly prevalent among individuals engaged in occupations requiring prolonged standing, such as teaching, and is considered one of the most frequent causes of heel pain in adults **[1]**.

Tightness in the calf muscles, namely the gastrocnemius and soleus, has been identified as a major contributing factor to plantar fasciitis. Calf tightness leads to limited ankle dorsiflexion, causing compensatory mechanics and increased stress on the plantar fascia during gait **[2]**. Addressing this muscular tightness is therefore a fundamental component of conservative management for plantar fasciitis.

Post-Isometric Relaxation (PIR), a subtype of Muscle Energy Technique (MET), is a manual therapy technique that involves an isometric contraction of the target muscle followed by relaxation and passive stretching. PIR is based on the principle of autogenic inhibition, where the isometric contraction is believed to increase the stretch tolerance and reduce muscle spindle activity, facilitating muscle elongation **[3]**.

Muscle Energy Techniques like PIR have been widely studied for their effects on improving flexibility, reducing pain, and restoring range of motion **[4]**. compared PIR with static stretching and found superior gains in hamstring flexibility **[5]**. reported the effectiveness of METs in alleviating musculoskeletal pain conditions, particularly in the cervical region. These findings highlight PIR's potential in addressing calf muscle tightness associated with plantar fasciitis.

The school teaching profession is known for its physically demanding nature, with prolonged hours of standing and walking on hard surfaces contributing to musculoskeletal stress. A study found that teachers had a higher prevalence of lower extremity

musculoskeletal disorders, including plantar fasciitis. Calf tightness, when unaddressed, can exacerbate plantar fascial stress, leading to chronic pain and functional limitations **[6]**. Traditional interventions for plantar fasciitis include rest, ice, non-steroidal anti-inflammatory drugs (NSAIDs), footwear modifications, orthotic supports, and stretching routines. However, these interventions primarily target symptoms rather than underlying biomechanical contributors like muscle tightness. Incorporating PIR can directly target gastrocnemius and soleus hypertonicity, thus addressing one of the root causes of plantar fasciitis.

The weight-bearing lunge test (WBLT) is a reliable and valid clinical tool for assessing ankle dorsiflexion range of motion and calf muscle flexibility. According to a study, the WBLT is strongly correlated with functional outcomes in lower extremity performance **[7]**. Similarly, the Numeric Pain Rating Scale (NPRS) is a validated and simple tool for assessing pain intensity and tracking changes over time **[8]**.

Given the occupational demands faced by school teachers and the biomechanical implications of calf muscle tightness on plantar fascia stress, this study investigates the effectiveness of PIR in reducing calf tightness and alleviating pain in this population. The primary objective is to determine whether PIR improves functional range of motion as measured by the WBLT and reduces subjective pain levels as assessed through NPRS.

OBJECTIVE

This study addresses a gap in the literature by focusing on a specific occupational group—school teachers—who are particularly vulnerable to plantar fasciitis due to long hours of weight-bearing activity. By targeting the muscular tightness component using PIR, this research offers potential for non-invasive and cost-effective intervention strategies to improve quality of life and occupational productivity.

METHOD

This is experimental research from DPS school in Ahmedabad. 30 teachers were recruited for the study. An informed consent form authorized by the University Ethics Committee was signed by the participants. To collect demographic data, each participant was requested to fill out an information questionnaire. The nature of the research, the methodology, and the tests that would be used throughout the study were all explained to the subjects.

Inclusion Criteria are teachers aged 25–50 years, clinically diagnosed with plantar

fasciitis (pain at the medial calcaneal tubercle and first steps pain in the morning, Presence of bilateral calf tightness, confirmed by the weight-bearing lunge test (dorsiflexion angle <35°), Symptom duration ≥ 4 weeks **[9, 11]**.

Exclusion Criteria are History of lower limb fracture or recent surgery (<6 months), Neurological deficits affecting lower limbs, any inflammatory joint disease or systemic rheumatologic condition, Corticosteroid injection in the past 3 months, Previous participation in calf stretching/strengthening interventions within last 6 weeks **[9, 11]**.

Outcome Measures

1. Weight-Bearing Lunge Test (WBLT) – to assess gastrocnemius-soleus flexibility. Participants performed a forward lunge keeping the heel flat; the distance from the big toe to the wall was measured in centimeters or dorsiflexion angle measured with an inclinometer. This test has high intra- and inter-rater reliability (ICC > 0.90) **[12]**.

2. Numeric Pain Rating Scale (NPRS) – to assess pain intensity during activity. Participants rated pain from 0 (no pain) to 10 (worst imaginable pain). NPRS is a valid and reliable tool for plantar heel pain with a minimal detectable change of \~1.9 points **[13]**.

Intervention Protocol [10,14]

Post-Isometric Relaxation (PIR) Technique for gastrocnemius and soleus:

Position: Participant in prone lying with foot extending beyond plinth edge.

Procedure

1. Therapist passively stretched the gastrocnemius to the point of mild discomfort.
2. Participant performed isometric contraction (20% of maximal effort) of plantarflexors against therapist's resistance for 8–10 seconds.
3. Following contraction, participant relaxed, and therapist passively stretched the muscle to a new barrier for 20–30 second.
4. Repetitions: 3–5 per muscle per session.
5. Frequency: 3 sessions per week for 2 weeks (total 6 sessions).

Both gastrocnemius and soleus were treated bilaterally in each session.

Additional Advice Given:

- Education on avoiding prolonged standing without supportive footwear.
- Recommendation for gentle self-stretching between sessions without overloading plantar fascia.

Procedure

1. Participants were screened for eligibility and baseline values for WBLT and NPRS were recorded (Pre-test).
2. PIR intervention was administered as per the protocol

3. Post-test readings were taken immediately after the 2-week intervention period.

4. All assessments were performed by the same blinded assessor to reduce measurement bias.

STATISTICAL ANALYSIS

Statistical analysis is done using SPSS version 26.

Normality of pre- and post-intervention scores for WBLT and NPRS was assessed using the Shapiro–Wilk test.

Since the data met normality i.e. ($p > 0.05$), paired t-tests were applied to compare pre- and post-intervention values within the group. Effect sizes were calculated using Cohen's d. The level of significance was set at $p < 0.05$.

Tables 1, 2 showed that there was a statistically significant improvement in ankle dorsiflexion (WBLT) and reduction in pain (NPRS) following the PIR intervention ($p < 0.001$ for all outcomes). Effect sizes were large, indicating strong clinical relevance.

Table 1: Normality Test Results (Shapiro–Wilk Test)

Variable	Pre-test (p value)	Post- test (p value)	Normality status
WBLT (Right)	0.112	0.083	Normal
WBLT (left)	0.091	0.072	Normal
NPRS	0.147	0.098	Normal

Table 2: Pre- and Post-Intervention Comparison (Paired t-test)

Outcome	Pre- test (Mean SD)	Post- test(Mean SD)	Mean difference	t-value	p-value	Cohen's value
WBLT (Right)	7.85 ± 1.20	10.34 ± 1.15	+2.49	12.45	<0.001	2.27
WBLT (Left)	7.62 ± 1.18	10.12 ± 1.11	+2.50	12.71	<0.001	2.32
NPRS	7.10 ± 0.88	3.25 ± 0.74	–3.85	21.84	<0.001	3.99

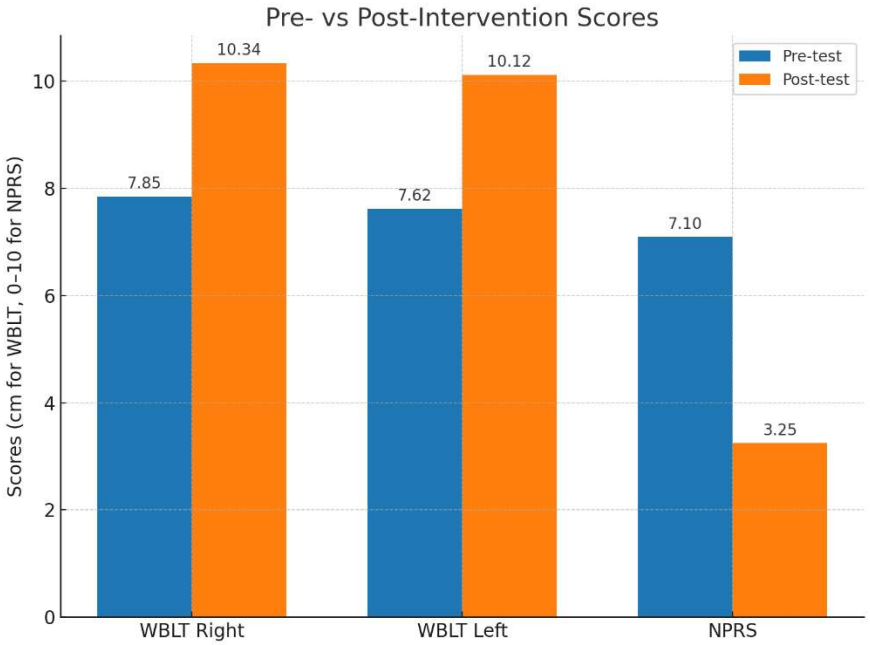

Figure 1: Pre- and Post-Intervention Scores

DISCUSSION

The present study aimed to evaluate the effect of Post-Isometric Relaxation (PIR) technique on bilateral calf muscle tightness and pain in school teachers with plantar fasciitis. The results demonstrated a significant improvement in ankle dorsiflexion range of motion as measured by the Weight-Bearing Lunge Test (WBLT) and a substantial reduction in pain on the Numeric Pain Rating Scale (NPRS) after a 2-week PIR intervention.

Effect on Calf Muscle Flexibility

The significant increase in WBLT values in both right and left limbs indicates that PIR effectively improved gastrocnemius-soleus flexibility. PIR works on the principle of post-isometric autogenic inhibition where a submaximal isometric contraction is followed by passive stretching, leading to increased muscle length through reduced muscle spindle activity and increased Golgi tendon organ activation **[15, 16]**.

Our findings are in agreement with Shamsoddini *et al*. (2010), who reported that PIR produced greater improvements in hamstring flexibility compared to static stretching in healthy adults **[20]**. Similarly, Chaitow and DeLany (2008) noted that PIR can produce immediate and sustained increases in muscle length due to both neuromuscular and viscoelastic adaptations **[16]**.

In the context of plantar fasciitis, calf tightness is a major contributing factor as it limits ankle dorsiflexion and increases strain on the plantar fascia during gait **[17, 18]**. By improving calf flexibility, PIR may reduce mechanical stress on the fascia, leading to symptomatic relief **[17]**.

Effect on Pain

NPRS scores significantly decreased post-intervention, indicating clinically meaningful pain reduction **[19]**. Pain relief could be attributed to the improved calf flexibility, which may have reduced plantar fascia loading, as well as PIR's potential to modulate the stretch reflex and promote relaxation of hypertonic muscles **[15, 16, 19]**.

Our findings align with the work of Radford *et al*. (2006), who found that calf stretching programs reduced plantar heel pain and improved dorsiflexion in patients with plantar fasciitis **[3]**. Additionally, Lewit (1999) suggested that PIR not only addresses muscle length but can also have a pain-relieving effect via reflex inhibition of muscle tone **[15]**.

Comparison with Existing Literature

While static stretching is commonly prescribed for plantar fasciitis, evidence suggests that contract–relax and PIR methods may yield faster gains in flexibility **[20, 21]**.

Shamsoddini *et al*. (2010) demonstrated that PIR improved flexibility significantly more than static stretching after just one session **[20]**.

A possible explanation for our findings is that PIR integrates both a neurological component (inhibition of muscle tone) and a mechanical component (viscoelastic elongation), producing superior results compared to conventional stretching alone **[16, 21]**.

CONCLUSION

Post-Isometric Relaxation appears to be a promising therapeutic approach in reducing calf muscle tightness and pain in school teachers with plantar fasciitis. This study supports the need for further research with a larger sample size to establish the clinical effectiveness of PIR.

ACKNOWLEDGEMENT

I would like to take this opportunity to heartily acknowledge those who helped me throughout our project work. This would not been possible without them. I would like to express our deep sincere gratitude to our respected guide Dr. Sonal Thakkar for her keen interest shown in our project work.

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