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Immediate Effect Of Resistance Based Quadriceps Exercise Versus Passive Stretching Of Hamstring On Hamstring Tightness Among Physiotherapists

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Abstract: Hamstring tightness is common among physiotherapists due to prolonged standing, bending, and assisting patients, leading to muscular stiffness, postural imbalances, reduced flexibility. It is caused by sedentary lifestyles, prolonged sitting, inadequate stretching/overuse, increasing the risk of low back pain, musculoskeletal dysfunction, gait abnormalities, & chronic pain, especially in physiotherapists prone to adaptive muscle shortening due to work-related demands. Quadriceps strengthening may enhance hamstring relaxation through reciprocal inhibition, while passive stretching of Hamstring improves flexibility. Identifying effective interventions is crucial for enhancing functional movement. Aim of the study is to evaluate the immediate effects of both interventions to determine the most effective strategy for improving hamstring flexibility.Sixty physiotherapists aged 18-25 years with hamstring tightness (AKE Test ≥ 20°) were randomly divided into two groups. Group A (Strengthening Group) performed seated quadriceps resistance exercises 2-3 kg, (3 sets of 10 reps at 1RM), Group B (Stretching Group) performed passive hamstring stretching (30 sec × 3 sets). Hamstring flexibility was assessed pre- and post-intervention using the AKE Test, and a paired t-test analyzed differences. Both groups showed statistically significant improvement ($p < 0.05$). The Stretching Group (Group B) demonstrated greater immediate improvement, with an average AKE reduction of 11.7°, compared to 6.8° in the Strengthening Group (Group A). Passive stretching provides greater immediate improvements in hamstring flexibility than quadriceps strengthening. Strengthening may help maintain flexibility & neuromuscular stability over time. A combined approach may optimize short-term gains and long-term musculoskeletal resilience.

Index Terms: Hamstring tightness, passive stretching, quadriceps strengthening, physiotherapists, Active Knee Extension (AKE) Test

I. INTRODUCTION

The main muscle responsible for controlling hip and knee movement is the hamstring. and regulate the spine's and pelvis' alignment. They therefore have a significant impact on postural alignment, as hamstring shortening may cause a posterior pelvic tilt and lumbar spine hypolordosis. (1). Hamstring consist of three muscles: the biceps femoris, semitendinosus, and semimembranosus, which play a critical role in hip extension, knee flexion, and overall lower-body movement. They make it easier to run, jump, and walk, among other exercises. Tight hamstrings can affect all of these activities and limit mobility. They could feel more hard and less flexible (2).

Hamstring tightness is defined as the inability to extend the knee to less than 20 degrees of knee flexion with the femur held at 90 degrees of hip flexion while the person will be positioned in supine. One of the most common injuries to the muscles and tendons in the lower leg is a hamstring strain. These injuries often happen again,andtheyare quite common. About 32%ofall muscle strains and11%of all injuries are hamstring strains [4]. High prevalence of hamstring tightness has been observed among physiotherapists and related healthcare professionals[3]. Various articles show prevalence of hamstring tightness:

Population	Prevalence of Hamstring Tightness
Physiotherapists (Faisalabad) [3].	77.5% (AKE test)
Healthcare Workers (Pakistan)	30.6% among physiotherapists
Orthopaedic Surgeons (India)	87.1% exhibited tightness

CAUSES OF HAMSTRING TIGHTNESS:

From sedentary persons to athletes, hamstring tightness can affect people of all activity levels. It is frequently associated with extended sitting, insufficient stretching, or overuse during physical activity. It could result in pain, restricted movement, and a higher chance of damage, including strained muscles or back pain [2].

SYMPTOMS can arise from overexertion or intense physical activity: [5]

1. Leg stiffness and restricted movement
2. Back of the thigh cramping ache.
3. After vigorous action, swelling and bruising may occur.
4. The hamstring region is red and sore.
5. The inability to bear weight on the leg due to weakness in the rear of the thigh

Physical fitness heavily relies on flexibility; in order to prevent sports injuries, it's critical to allow for a sufficient range of motion [4].In addition to hamstring mobilisation and stretching, strengthening the quadriceps, the opposite muscle group, is crucial for treating tight hamstrings. In addition to improving posture and lowering strain on the posterior chain (hamstrings and glutes), strong quadriceps aid in knee joint stabilisation. Quadriceps-focused resistance-based workouts can help with long-term hamstring flexibility gains, imbalance correction, and the promotion of healthy movement patterns. This manual provides a list of safe and efficient resistance-based quadriceps workouts that are tailored for those with hamstring tightness.

These movements minimize excessive hamstring engagement while emphasizing quad strength, control, and joint alignment [6]. In order to address muscle imbalances that either cause or contribute to hamstring tightness, it can be quite helpful to strengthen the quadriceps, which are the muscles in the front of the thighs. Underactive or weak quadriceps frequently coexist with tight hamstrings. By altering the pelvic tilt, this imbalance may put strain on the hips and spine. The quadriceps are important knee stabilisers, particularly the vastus medialis oblique (VMO). The hamstrings and glutes are more frequently used to stabilise the leg when walking or running when the quadriceps are weak. The hamstrings can gradually relax and extend when the overworked posterior chain muscles are relieved by strong quadriceps [7].

A stretching program lasting several days has been shown to increase hamstring flexibility [4]. Proprioceptive neuromuscular facilitation, ballistic stretching, and static stretching are the three forms of stretching that have historically been identified in the literature as methods for improving flexibility. Putting a body part in a specific posture during a stretching exercise helps to lengthen and elongate the muscle or muscle group, increasing its suppleness and flexibility [8].

Effects of Stretching:

1. Increases flexibility, which delays age-related mobility impairments
2. Enhances performance in physical activities due to increased flexibility
3. Lowers the possibility of damage and injury
4. Reduces muscle discomfort and recuperation time by increasing blood circulation.
5. Extending the range of movement.

The slow-paced, regulated physical activity known as static stretching (SS) is positioning a body component in a comfortable position that allows the muscle to lengthen with little force for an extended period of time (about 30 seconds) without producing pain.

Statics stretching comes in two forms:

1.Active-static stretching is static stretching done on your own

2. Passive-static stretching is the practice of stretches without the use of an external force, such as gravity, a partner, or an accessory [8].

II. MATERIALS AND METHODOLOGY

METHOD OF DATA COLLECTION:

The data for this interventional study was collected from Outpatient Department (OPD) centers and physiotherapy colleges located in Ahmedabad. The study population consisted of individuals aged between 18 to 25 years. A convenient sampling method was employed to recruit participants, resulting in a total sample size of 60 individuals. Active Knee Extension (AKE) was used to assess hamstring tightness.

MATERIALS REQUIRED:

- Bed
- Goniometer
- Weight cuffs (2-3 kgs)
- Pillow

III. SELECTION CRITERIA

INCLUSION CRITERIA

- Male and female physiotherapists.
- Age range: 18–25 years**.**
- Presence of hamstring tightness**,** defined as Active Knee Extension (AKE) Test ≥ 20°**.**
- Willingness to participate in the study.
- Ability to comply with the intervention protocol throughout the study duration.

EXCLUSION CRITERIA

- No history of recent hamstring injury or surgery,
- No neuromuscular or musculoskeletal disorders affecting lower limb function.
- Recent lower limb fractures or trauma.
- Any medical condition restricting exercise participation
- Orthopedic conditions (e.g., knee osteoarthritis, hip dysfunction).

IV. PROCEDURE

a. Ethical clearance was taken
b. Selection based on criteria
c. entire process was explained
d. Take consent
e. Pre & post AKE were recorded

ACTIVE KNEE EXTENSION TEST (AKE)

The Active Knee Extension (AKE) test measures the amount of knee extension with the hip flexed at a 90-degree angle in order to evaluate hamstring flexibility. The individual is assisted to remain in this position during the test while lying supine on a level surface or treatment table with their hips flexed to 90 degrees. In order to actively straighten the knee as much as possible while maintaining a fixed hip, the participant must begin with the knee bent at around a 90-degree angle. The angle of knee extension is then measured using a goniometer, where the axis is positioned over the femur's lateral epicondyle, the moving arm is positioned in relation to the lateral malleolus, and the stationary arm is positioned in relation to the greater trochanter.

figure1: start and end position of active knee extension test

- GROUP A:

  - 30 participants performed seated quadriceps resistance exercises using weights ranging from 2 to 3 kilograms.
  - The exercise protocol consisted of three sets of 10 repetitions at 1 Repetition Maximum (1RM), with appropriate rest periods between each set.
  - The exercises were conducted in a high sitting position under direct supervision to ensure correct form and safety.
  - Pre- and post-intervention Active Knee Extension (AKE) tests were administered using a goniometer to measure changes in hamstring flexibility.
  - The intervention was based on the principle of reciprocal inhibition, where contraction of the quadriceps muscle leads to relaxation of the hamstrings, thereby improving flexibility and reducing tightness.

figure 2: seated quadriceps exercise using weight cuff

- GROUP B:

  - Group B participants underwent a passive hamstring stretching intervention designed to improve flexibility and reduce muscle tightness.
  - Each participant performed the stretch in a supine position, with each stretch held for 30 seconds, repeated across three sets.
  - The sessions were carefully supervised to ensure proper technique and to prevent any compensatory movements that could affect the outcome.
  - To assess changes in hamstring flexibility, Active Knee Extension (AKE) tests were conducted before and after the intervention using a goniometer**.**
  - This method of gentle, sustained passive stretching is known to enhance flexibility by reducing muscle tension and promoting relaxation of the hamstring muscles.

figure 3: passive stretching of hamstring

V. STATISTICAL ANALYSIS

All statistical analyses were carried out using IBM SPSS Statistics software, version 26.0. The data were first entered into Microsoft Excel for initial tabulation and verification before being imported into SPSS for detailed statistical testing. Descriptive statistics, including mean and standard deviation (SD)**,** were calculated for all continuous variables to summarize pre- and post-intervention Active Knee Extension (AKE) test values for both groups.

To assess the assumption of normality, the Shapiro–Wilk test was applied to the post-intervention scores of each group. Since the p-values obtained were greater than 0.05, the data were considered normally distributed, thus justifying the use of parametric tests for further analysis.Within-group comparisons of pre- and post-intervention AKE values were analyzed using the paired t-test, in order to determine whether each intervention (quadriceps strengthening and passive stretching) led to significant improvements in hamstring flexibility. Between-group comparisons of post-intervention improvements were performed using the independent samples t-test, which assessed whether there was a statistically significant difference in the magnitude of flexibility gains between the strengthening and stretching groups.

The level of statistical significance was set at $p < 0.05$ for all analyses. Results were reported with corresponding t-values, mean differences, and p-values to provide clarity on the strength and direction of the observed effects.

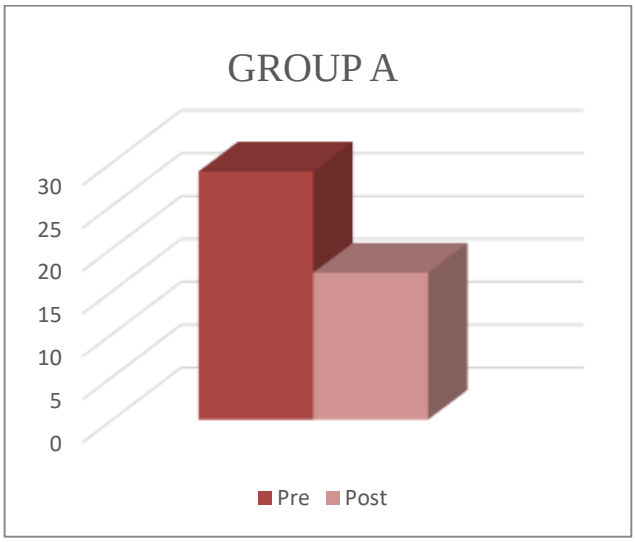
VI. RESULT

Independent samples t-test was conducted to compare post-intervention flexibility between the two groups. The analysis revealed a statistically significant difference ($p < 0.05$) in hamstring flexibility between Group A (Strengthening) and Group B (Stretching), indicating that while both interventions were effective in reducing hamstring tightness, the degree of improvement was greater in the stretching group.

In Group A (Strengthening group), where participants performed seated quadriceps resistance exercises using ankle weights, the mean pre-intervention AKE was 29.87°**,** while the mean post-intervention AKE decreased to 21.13°**,** representing a mean improvement of 8.73°**.** This reduction supports the hypothesis that quadriceps strengthening, based on the principle of reciprocal inhibition, promotes hamstring relaxation and subsequently improves flexibility.

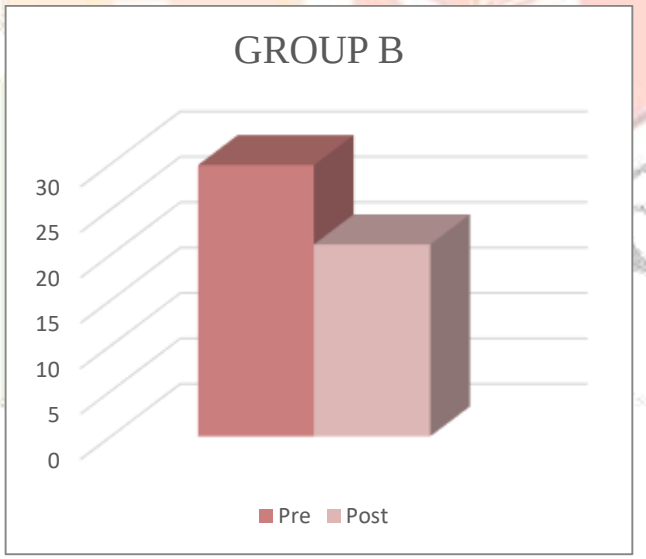
Although the improvement was statistically significant, the magnitude of change was comparatively smaller than that seen in the stretching group.

chat 1: pre and post scores of AKE using goniometer



In contrast, Group B (Stretching group**)**, which underwent passive hamstring stretching, demonstrated a mean pre-intervention AKE of 28.93° and a post-intervention mean of 17.13°**,** resulting in a mean improvement of 11.8°**.** This finding indicates that passive stretching produced a greater immediate increase in hamstring flexibility than strengthening, likely due to mechanisms such as viscoelastic muscle adaptation and autogenic inhibition.

chat 2: pre and post scores of AKE using goniometer



When comparing post-intervention mean AKE scores between groups, Group A recorded a mean of 18.13° (SD = 2.79), whereas Group B showed a higher mean of 22.13° (SD = 1.82). The mean difference between the groups was 4°, which was statistically significant ($p < 0.05$). This further reinforces the superior effect of passive stretching on immediate hamstring flexibility.

The Active Knee Extension (AKE) test, used as the objective outcome measure, confirmed that both interventions led to statistically significant improvements in flexibility from baseline to post-intervention within their respective groups. However, the greater reduction in AKE angle in the stretching group suggests that passive static stretching provides more immediate and pronounced benefits compared to isolated quadriceps strengthening.

Overall, the results of the present study demonstrate that while both quadriceps strengthening and passive hamstring stretching are effective strategies to address hamstring tightness among young physiotherapists, passive stretching appears to be the more efficient intervention for achieving rapid gains in flexibility**.**

Quadriceps strengthening, however, may hold additional value in long-term maintenance of flexibility and neuromuscular stability, indicating that a combined approach could be optimal in both clinical and preventive contexts.

VII. DISCUSSION

The present study evaluated the immediate effects of resistance-based quadriceps exercise and passive hamstring stretching on hamstring tightness among physiotherapists aged 18–25 years. Both interventions showed statistically significant improvements in hamstring flexibility as measured by the Active Knee Extension (AKE) test; however, passive stretching demonstrated greater immediate gains compared to quadriceps strengthening. These findings suggest that although both interventions are beneficial, stretching provides a more effective short-term method for reducing hamstring tightness.

The superior improvement seen with passive stretching can be explained by its physiological mechanisms. Stretching induces viscoelastic changes in the muscle-tendon unit, increases sarcomere length, reduces passive tension, and decreases stiffness, while also activating Golgi tendon organs that facilitate autogenic inhibition and allow greater muscle elongation (Sherry & Best, 2004; Sreelakshmi et al., 2018) [7],[4]. This neuromuscular mechanism provides an immediate benefit, which explains why stretching resulted in a larger gain in flexibility in the current study. In contrast, quadriceps strengthening relies on reciprocal inhibition, where activation of the quadriceps inhibits hamstring activity through spinal interneurons, leading to muscle relaxation[1]. While effective, this effect is subtler and more likely to contribute to gradual improvements and long-term musculoskeletal balance rather than immediate changes, which justifies the comparatively smaller improvement seen in the strengthening group.

Sreelakshmi et al. (2018) found that static stretching improved flexibility among physiotherapy students more effectively than eccentric training in the short term[4]. Similarly, Sherry & Best (2004) highlighted that stretching protocols are beneficial for immediate range of motion gains, while strengthening-based programs are crucial for rehabilitation and injury prevention. This dual mechanism reflects the importance of both strategies: stretching for quick relief and quadriceps strengthening for sustaining long-term flexibility and neuromuscular stability [7]. The association between hamstring tightness and low back pain reported by Faheem et al. (2025) among physiotherapists also underscores the occupational relevance of such interventions, since reduced flexibility can impair posture, increase lumbar strain, and predispose to musculoskeletal dysfunction[3]. Hence, combining both stretching and strengthening may be ideal, as stretching provides acute benefits while strengthening addresses long-term muscle imbalance and injury prevention.

The clinical implications of these findings are important. Physiotherapists are particularly prone to hamstring tightness due to prolonged standing, bending, and assisting patients, and incorporating simple stretching routines can provide immediate relief and flexibility improvements. However, strengthening the quadriceps should not be overlooked, as weak quadriceps with coexisting hamstring tightness contribute to postural dysfunction, altered pelvic tilt, and increased strain on the spine (Kendall et al., 2005; Faheem et al., 2025) [6], [3]. Therefore, a combined intervention involving both stretching and strengthening may be the most effective approach, offering synergistic benefits for both immediate flexibility and long-term musculoskeletal resilience.

While the study provides valuable insights, certain limitations should be acknowledged. The relatively small sample size and the inclusion of only physiotherapists aged 18–25 years limit the generalizability of the findings to other age groups and populations. Moreover, only the immediate effects of the interventions were assessed, and no follow-up was conducted to determine the sustainability of flexibility gains. Previous literature suggests that strengthening programs may require longer durations to demonstrate full benefits, whereas stretching provides rapid but potentially transient effects [7]. Thus, long-term studies with larger and more diverse populations are needed to evaluate the combined and sustained effects of these interventions. Furthermore, incorporating functional outcomes such as gait performance, postural alignment, and pain reduction may provide a more comprehensive understanding of their clinical value.

In summary, the present study demonstrated that both quadriceps strengthening and passive stretching are effective in reducing hamstring tightness among physiotherapists, with stretching producing greater immediate improvements. These results support the inclusion of stretching for rapid flexibility enhancement, while highlighting the role of quadriceps strengthening in maintaining long-term musculoskeletal balance. A combined approach may therefore be the most clinically relevant strategy, offering both short-term and long-term benefits to physiotherapists and other individuals prone to hamstring tightness.

VIII. CONCLUSION

Present study demonstrated that both resistance-based quadriceps exercise and passive hamstring stretching significantly improve hamstring flexibility in physiotherapists with tightness, as measured by the Active Knee Extension (AKE) test. However, passive stretching produced greater immediate improvements compared to quadriceps strengthening, suggesting it is more effective for short-term flexibility enhancement. Quadriceps strengthening, though less effective in the immediate term, may play an important role in promoting long-term neuromuscular stability and preventing recurrence of tightness. These findings highlight the clinical relevance of using passive stretching when rapid improvement is needed, while also emphasizing the importance of incorporating strengthening exercises for sustained musculoskeletal balance. A combined approach integrating both stretching and strengthening is therefore recommended to optimize short-term gains and long-term resilience in physiotherapists and other individuals prone to hamstring tightness.

IX. LIMITATIONS AND RECOMMENDATIONS

➢ Limitations

- Small sample size **(**n = 60**)** with convenience sampling.
- Only immediate effects assessed, no long-term follow-up.
- Narrow age group **(**18–25 years physiotherapists) → limited generalizability.
- Single outcome measure **(**AKE test) used.
- External factors (daily activity, prior routines) not controlled.

➢ Recommendations

- Conduct studies with larger, diverse samples.
- Include long-term follow-up for sustained effects.
- Explore combined stretching + strengthening programs.
- Add functional outcome measures (gait, posture, pain).
- Use EMG/imaging to study neuromuscular mechanisms.
- Perform multi-center RCTs for stronger validation.

REFERENCES

1. Bregenhof, B., Jorgensen, U., Aagaard, P., Nissen, N., Creaby, M.W., Thorlund, J.B. et al., 2018, 'The effect of targeted exercise on knee-muscle function in patients with persistent hamstring deficiency following ACL reconstruction – Study protocol for a randomized controlled trial,

2. DR.RASHMEET KAUR DECEMBER 5, 2024 HAMSTRING MUSCLE TIGHTNESS

3. Faheem, M., Aslam, M. N., & Tahir, R. (2025). *Association of hamstring tightness with low back pain and disability in physiotherapists*. Foundation University Medical & Health Sciences Journal, 5(1).
4. Sreelakshmi Dasappan, R Rejeesh Kumar and KS Sharad Effects of eccentric training and static stretching to improve hamstring flexibility among physiotherapy students
5. Hamstring tendonitis: Cleveland clinic
6. Kendall, F. P., et al. (2005). *Muscles: Testing and Function with Posture and Pain*. Lippincott Williams & Wilkins.
7. Sherry, M. A., & Best, T. M. (2004). "A comparison of 2 rehabilitation programs in the treatment of acute hamstring strains." *Journal of Orthopaedic & Sports Physical Therapy*, 34(3), 116–125.
8. Stretching: Physiopedia
9. Ploypailin Namkorn, M.Sc.1 , Wilawan Chaiut, Ph.D.1 , Chatchada Sutalangka, Ph.D 13 November 2024: Immediate Effect of Hamstring Stretching on Q Angle, Flexibility, and Balance in Individuals with Hamstring Tightness
10. Widodo AF, Tien CW, Chen CW, Lai SC. Isotonic and Isometric Exercise Interventions Improve the Hamstring Muscles' Strength and Flexibility: A Narrative Review. Healthcare (Basel). 2022 Apr 27;10(5):811. doi: 10.3390/healthcare10050811. PMID: 35627948; PMCID: PMC9140507.